



# Ichthyofaunal diversity and vertical distribution patterns in the rockpools of the southwestern coast of Yaku-shima Island, southern Japan

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**Abstract:** The community composition of rockpool fish on the southwestern coast of Yaku-shima Island, southern Japan, in the northwest Pacific was investigated by sampling of 22 rockpools and recording the range of vertical heights (a total of 76 sampling events from May 2009 to February 2010). A total of 72 species belonging to 19 families were collected from the study site. This species richness is the highest recorded of similar studies undertaken worldwide, reflecting the highest diversity of coastal fishes in the western Pacific. Increases in species richness due to transient and accidental visitors increased the total number of species in the lower vertical zones. Variations in the vertical distribution pattern of the resident and transient species suggests habitat partitioning and/or physical preferences for a particular habitat of each species. Color images of rockpool fish recorded at the site and a list of all the voucher specimens are provided.

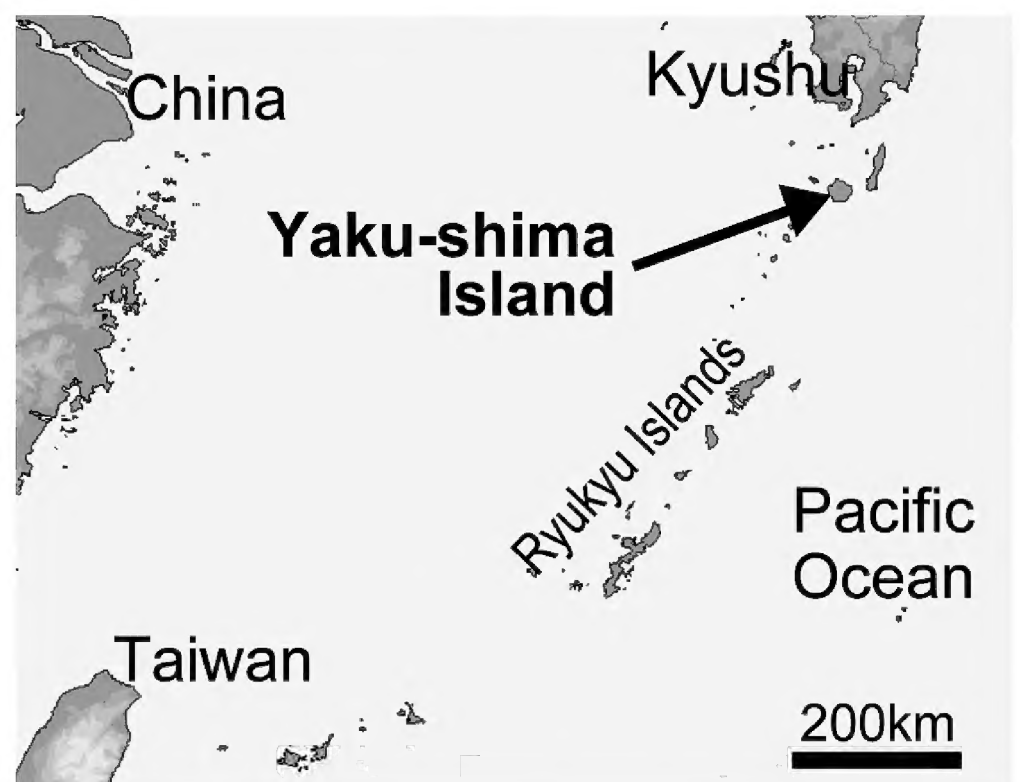
**Key words:** coastal fish diversity, intertidal rocky shore, northwestern Pacific, spatial distribution

## INTRODUCTION

Yaku-shima Island is located in the subtropical region of southern Japan, in the northwestern Pacific (30°20' N, 130°32' E, approximately 60 km south-southwest of the southernmost tip of Kyushu Island; Figure 1), surrounded by a strong, warm ocean current from the south (the Kuroshio Current) and multidirectional, irregular currents from Kyushu Island (Motomura et al. 2010). Despite the uniform rocky shore that surrounds almost the entire island, it is of interest biogeographically because of the mix of ocean currents. Ichthyofaunal surveys have been undertaken resulting

in a total of 988 marine and estuarine fish species being listed from compiled literature sources, underwater photographs and voucher specimens (Motomura et al. 2010; Motomura and Aizawa 2011; Murase et al. 2011).

To identify the temporal dynamics of the coastal fish assemblage of Yaku-shima Island, Murase (2013) *quantitatively* sampled the intertidal rocky shore and investigated the community structure of rockpool fish on the southwestern coast of the island over four seasons. His results showed a statistically stable diversity throughout the year at the study site, although seasonal variability of species richness and fish density was detected. Furthermore, the species richness of the rockpool fish recorded in Murase's study (54 species) represented the highest number compared to other similar studies in the Indo-Pacific region (Moring 1986; Varas and Ojeda 1990; Willis and Roberts 1996; Beckly 2000; Griffiths 2003a; Castellanos-Galindo et al. 2005; Arakaki and Tokeshi 2006;



**Figure 1.** Map showing the position of Yaku-shima Island.



**Figure 2.** Rocky shore environment of Kurio Beach, southwestern coast of Yaku-shima Island. Small window showing the rockpools at the study site. Photos taken May 2009.

Murase et al. 2010; Cox et al. 2011). But, Murase (2013) did not consider the spatial distribution pattern of the rockpool fish assemblage in relation to the vertical levels of each rockpool sampled. This study aims to describe the rockpool ichthyofauna of the entire intertidal zone on the southwestern coast of Yaku-shima Island and the variability of species in relation to their vertical height, by updating Murase's (2013) data as follows: sampled rockpools were divided into various vertical zones, and included rockpools at exposed zones which had been not included in Murase (2013). Color images of the rockpool fish and a catalogue of the voucher specimens collected in this study are also provided.

## MATERIALS AND METHODS

The study site was located on a rocky shore of Kurio Beach, on the southwestern coast of Yaku-shima Island (30°16' N, 130°24' E; Figure 2), detailed information of which was provided in Murase (2013). To record the entire fish fauna inhabiting intertidal rockpools at the site, 22 rockpools were randomly selected that were located at different vertical heights from the nearly lowest low water level (NLLWL) and fish sampling was carried out during the daytime at spring tides over four seasons (May, July, October 2009 and February 2010). Heights of each rockpool surface from the NLLWL were measured by the two-pole method (see Murase et al. 2010: Figure 1) along with the estimated tidal height around the Kurio Beach which was provided by the Hydrographic and Oceanographic Department of the 10th Regional Coast Guard Headquarters (Kagoshima, Japan). Rockpools were categorized into the following five vertical zones: higher zone ( $n = 4$ , 2.01–2.22 m from NLLWL); mid-higher zone (4, 1.37–1.75 m); mid-lower zone (4, 1.32–1.34 m); lower zone (4, 0.85–1.02 m); and the exposed zone (6, 0.16–0.94 m). Of these, although

the lower and exposed zones shared the same elevation at 0.85–0.94 m, the zones differed in terms of their exposure to waves, or specifically, the exposed zone was much nearer to the surge zone and was more affected by waves than the lower zone. Due to its location, it was not possible to enter the exposed zone to sample fish during autumn and winter (October and February in this study), as the tidal height at low tide was higher here in the daytime. Therefore sampling events were divided in two terms: Term I, in May and July 2009 included the exposed zone, and Term II, in October 2009 and February 2010 excluded the exposed zone. Fish sampling was performed once at each rockpool in each month (22 pools  $\times$  2 months + 16 pools  $\times$  2 months = 76 sampling events in total) by completely emptying the rockpool with a bucket and a mug as in Murase (2013). The rockpool volumes ranged from 0.05–1.79 m<sup>3</sup>. The captured fish were immediately killed in an ice box, packed in plastic bags and transported to the laboratory. They were fixed with 10% formalin and conserved in 70% alcohol. Some were photographed when fresh to provide good color images. All the specimens collected were deposited in the ichthyological collection of the Kanagawa Prefectural Museum of Natural History, Japan (KPM-NI) and the numbers are listed in the Appendix.

The taxonomic arrangement of families followed Nelson (2006). Fish identification and standard lengths (SL) were according to Nakabo (2013), and the taxonomic-revised groups were described as follows: Murase (2013) considered species of *Scorpaenodes* as "*Scorpaenodes* spp." because of a taxonomic problem between *S. guamensis* and *S. scaber* following a personal communication from Dr. H. Motomura (Kagoshima University Museum), however, thereafter Motomura (2014) stated that *S. scaber* was an endemic species of



Australia and was not distributed in Japanese waters. Following this, specimens of *Scorpaenodes* were identified as *S. guamensis*. Motomura et al. (2010) reported an unidentified species of *Enneapterygius* as *E. sp. 5*, and that species has recently been identified as the nuptial phase of *E. leucopunctatus*, although the distinctive characteristics of females of *E. leucopunctatus* and *E. hemimelas* still remain unclear (S. Tashiro, Kagoshima University, personal communication). Additionally, some *Enneapterygius* individuals were treated as “*E. leucopunctatus* or *E. hemimelas*”. *Enneapterygius* sp. in Meguro (2013), which is the same species as *Enneapterygius* sp. 1 of Motomura et al. (2010), were listed here as “*Enneapterygius* sp. (*sensu* Meguro, 2013)”. Murase (2013) listed *Praealticus margaritarius*, but the scientific name was revised as *P. bilineatus* (Nakabo 2013). Information on *Palutrus* cf. *reticularis* (Gobiidae), *Istiblennius edentulus* and *I. enosimae* (Blenniidae) was based on Murase (2013). All species recorded in this study were divided into three life-style status categories (residents, transients and accidental visitors) according to the definition of Murase (2013).

The occurrence rates of the fish species in each vertical zone were calculated in each term as the “frequency of occurrence in the species within a zone/frequency of sampling event within the zone  $\times$  100 (%)”. Four rockpools were sampled twice (2 months) within a single zone, making eight sampling events in total within a single zone for each term, with the exception of the exposed zone, where 12 sampling events were carried out during Term I only. Therefore, for example, the occurrence rate of a fish species collected in five sampling events within the higher zone during a single term was shown as, “ $5/8 \times 100 = 62.5$  (%)”. The occurrence rates of each recorded species are listed in Table 1.

## RESULTS

The rockpool fish sampling (a total of 76 sampling events from 22 rockpools over four months from May 2009 to February 2010) at Kurio Beach, Yaku-shima Island, resulted in 4041 individuals belonging to 72 species of 19 families. The fish species collected in this study are listed in Table 1 according to their family and species abundance, and their images are shown in Figures 3–9. Blenniidae and Gobiidae were the most speciose families, with 13 species (18.1% of the total) in each, followed by the Tripterygiidae (8 species, 11.1%), Labridae (7, 9.7%), Pomacentridae (6, 8.3%), Scorpaenidae (4, 5.6%) and the others (< 4 species, 5.0% of the total, in each). The most abundant family was the Blenniidae (1988 individuals, 49.2% of the total) followed by the Gobiidae (1301, 32.2%), Tripterygiidae (315, 7.8%), Labridae (259, 6.4%), Pomacentridae (89, 2.2%), and the others (< 20 individuals, 0.5% of the total, in each family). The most abundant species were *Eviota prasina*

(945 individuals, 23.4% of the total), *Praealticus bilineatus* (705, 17.4%), *P. tanegasimae* (628, 15.5%), *Rhabdoblennius nitidus* (554, 13.7%), *Bathygobius cocosensis* (272, 6.7%), *Thalassoma cupido* (235, 5.8%), *Enneapterygius philippinus* (139, 3.4%), *En. etheostoma* (57, 1.4%), *Enneapterygius* sp. (48, 1.2%), *B. coalitus* (42, 1.0%) and the other species were < 1.0% of the total. Of these predominant species, *P. bilineatus*, *P. tanegasimae*, *R. nitidus*, *B. cocosensis* and *En. philippinus* were considered common species, as they were predominant and occurred over four seasons in the study by Murase (2013). This trend in the rockpool fish assemblage, such as the predominance of blenniids and gobiids followed by other transient groups (Tripterygiidae, Labridae and Pomacentridae) mirrored the results of Murase (2013). In terms of life history status, the most speciose category was the accidental visitor (32 species, 44.4% of the total) followed by transient (27, 37.5%) and resident (13, 18.1%) species.

The relationships between the vertical levels and the number of species in each life history status are shown in Figure 10. In Term I, total species richness did not vary much from the higher to mid-lower zones (a range of 15–19 species), but this increased to 30 and 41 species in the lower and exposed zones, respectively. Similarly, in Term II, the total number of species remained stable between the higher and mid-lower zones (12–16 species) and increased ~twofold in the lower zone during Term II (26 species). Species richness of the resident species ranged from 8–10 species (Term I) and 7–10 species (Term II), and did not show any clear vertical distribution. Species richness of the transients varied from 7–8 (Term I) and 3–9 (Term II) from the higher to the lower zone, however, 17 species of transients were recorded in the exposed zone of Term I. Species richness of the accidental visitors increased in inverse proportion to vertical height. During Term I, 0–3 species of accidental visitors occurred in the higher to mid-lower zones, and 12 and 15 species were recorded in the lower and exposed zones, respectively. During Term II, no accidental visitors were recorded in the higher and mid-lower zones, however, seven species were recorded in the lower zone.

The six common species showed various occurrence patterns along the vertical zones (Table 1). *P. bilineatus* occurred more frequently between the mid-higher and lower zones during both terms. *P. tanegasimae* was generally found in the higher rockpools, and in particular, was always (100%) found in the higher zone. *R. nitidus* was less frequent at the higher zones, but more common at the lower zone. *Ev. prasina* was distributed similarly to *R. nitidus*, but always occurred in the two lowest zones. *B. cocosensis* was found equally throughout all vertical zones (62.5–75.0%). *En. philippinus* was found more frequently (75.0–100.0%) at the lower zone in both terms. The two gobiid residents (which were not common

**Table 1.** List of rockpool fish species and their occurrence rates in each vertical zone at Kurio Beach, Yaku-shima Island. Families and species are listed in order of total abundance.

Family and species name		Life style	n	status	SL (mm)	Term I (with exposed zone)					Term II (without exposed zone)						
						Vertical zone and occurrence rate (%)					Vertical zone and occurrence rate (%)						
						High	M high	M low	Low	Exposed	n	High	M high	M low	Low	n	
<b>Blenniidae</b>																	
<i>Praealticus bilineatus</i> (Peters, 1868)		R	705		12.0–75.4	-	100.0	75.0	100.0	50.0	359	75.0	100.0	100.0	87.5	346	
<i>Pra. tanegasimae</i> (Jordan & Starks, 1906)		R	628		12.2–89.6	100.0	100.0	50.0	12.5	16.7	343	100.0	50.0	50.0	-	285	
<i>Rhabdoblennius nitidus</i> (Günther, 1861)		R	554		11.8–70.0	25.0	75.0	75.0	87.5	83.3	392	-	75.0	62.5	100.0	162	
<i>Istiblennius edentulus</i> (Forster & Schneider, 1801)		R	28		22.7–100.8	50.0	25.0	12.5	12.5	8.3	13	37.5	37.5	37.5	37.5	15	
<i>I. edentulus</i> or <i>I. enosimae</i>		R	20		17.2–55.0	25.0	-	-	50.0	16.7	13	25.0	-	12.5	25.0	7	
<i>Entomacrodus striatus</i> (Valenciennes, 1836)		T	15		15.3–71.3	-	-	-	-	58.3	15	-	-	-	-	-	
<i>I. enosimae</i> (Jordan & Snyder, 1902)		R	11		28.8–104.7	-	25.0	-	25.0	8.3	5	12.5	25.0	12.5	12.5	6	
<i>I. lineatus</i> (Valenciennes, 1836)		R	9		18.1–54.2	25.0	-	-	-	-	2	37.5	-	-	-	7	
<i>Salarias sinuosus</i> Snyder, 1908		T	6		15.5–52.4	-	-	-	12.5	16.7	6	-	-	-	-	-	
<i>Omobranchus loxozonus</i> (Jordan & Starks, 1906)		R	5		42.1–49.5	-	-	-	25.0	-	4	-	-	-	12.5	1	
<i>Ent. thalassinus thalassinus</i> (Jordan & Seale, 1906)		T	2		30.5–35.5	-	-	-	-	8.3	2	-	-	-	-	-	
<i>I. dussumieri</i> (Valenciennes, 1836)		R	2		33.5–40.9	-	-	-	-	-	-	12.5	-	-	-	2	
Blenniidae unidentified species		-	1		16.8	-	-	-	-	-	-	-	-	12.5	-	1	
<i>Ent. caudofasciatus</i> (Regan, 1909)		T	1		35.3	-	-	-	-	8.3	1	-	-	-	-	-	
<i>Sa. luctuosus</i> Whitley, 1929		T	1		13.0	-	-	-	12.5	-	1	-	-	-	-	-	
<b>Gobiidae</b>																	
<i>Eviota prasina</i> (Klunzinger, 1871)		R	945		7.4–27.8	37.5	87.5	75.0	100.0	100.0	683	62.5	87.5	75.0	100.0	262	
<i>Bathygobius cocosensis</i> (Bleeker, 1854)		R	272		7.7–41.6	62.5	62.5	75.0	75.0	75.0	161	75.0	75.0	75.0	75.0	111	
<i>B. coalitus</i> (Bennett, 1832)		R	42		9.0–71.7	75.0	-	12.5	12.5	-	16	37.5	-	25.0	12.5	26	
<i>Priolepis semidoliata</i> (Valenciennes, 1837)		R	18		6.6–30.4	-	-	-	37.5	41.7	12	-	-	-	37.5	6	
<i>Ev. abax</i> (Jordan & Snyder, 1901)		R	8		13.5–30.0	37.5	12.5	12.5	-	8.3	6	-	-	12.5	12.5	2	
<i>Ev. japonica</i> Jewett & Lachner, 1983		T	5		20.0–23.8	37.5	-	-	-	-	5	-	-	-	-	-	
<i>B. corticeps</i> (Steindachner, 1880)		T	4		22.3–39.1	-	12.5	-	-	-	1	-	12.5	-	-	3	
<i>B. cyclopterus</i> (Valenciennes, 1837)		T	2		8.7–12.6	-	-	-	-	-	-	12.5	-	-	-	2	
<i>Asterropteryx semipunctata</i> Rüppell, 1830		T	1		16.6	-	-	-	12.5	-	1	-	-	-	-	-	
<i>Cabillus tongarevae</i> (Fowler, 1927)		AV	1		21.4	-	-	-	12.5	-	1	-	-	-	-	-	
<i>Palutrus</i> cf. <i>reticularis</i> Smith, 1959		AV	1		17.0	12.5	-	-	-	-	1	-	-	-	-	-	
<i>Pri. borea</i> (Snyder, 1909)		AV	1		10.4	-	-	-	12.5	-	1	-	-	-	-	-	
<i>Pri. cincta</i> (Regan, 1908)		AV	1		16.6	-	-	-	-	8.3	1	-	-	-	-	-	
<b>Tripterygiidae</b>																	
<i>Enneapterygius philippinus</i> (Peters, 1869)		T	139		13.5–29.8	-	62.5	25.0	100.0	33.3	120	-	12.5	-	75.0	19	
<i>Enn. etheostoma</i> (Jordan & Snyder, 1902)		T	57		12.2–40.7	-	25.0	-	62.5	41.7	55	-	-	-	25.0	2	
<i>Enn. sp.</i> (sensu Meguro, 2013)☒		T	48		11.1–29.5	-	-	-	-	66.7	48	-	-	-	-	-	
<i>Enn. leucopunctatus</i> Shen, 1994		T	27		17.8–32.7	-	-	-	-	50.0	27	-	-	-	-	-	
<i>Enn. bahasa</i> Fricke, 1997		T	15		14.1–32.1	-	-	-	-	33.3	15	-	-	-	-	-	
<i>Enn. hemimelas</i> or <i>E. leucopunctatus</i>		T	13		13.6–32.7	-	-	-	-	41.7	13	-	-	-	-	-	
<i>Helcogramma fuscipictoris</i> (Fowler, 1946)		T	8		16.2–29.4	-	-	-	-	25.0	8	-	-	-	-	-	
<i>Enn.</i> unidentified species		-	4		11.2–14.4	-	-	-	-	8.3	4	-	-	-	-	-	

Continued

Table 1. Continued.

Family and species name		Life style	Term I (with exposed zone)										Term II (without exposed zone)			
			Vertical zone and occurrence rate (%)										Vertical zone and occurrence rate (%)			
			n	status	SL (mm)	High	M high	M low	Low	Exposed	n	High	M high	M low	Low	n
<i>Enn. hemimelas</i> (Kner & Steindachner, 1867)		T	2		20.8–27.9	-	-	-	-	16.7	2	-	-	-	-	-
<i>He. inclinatum</i> (Fowler, 1946)		AV	2		14.3–14.8	-	-	-	12.5	8.3	2	-	-	-	-	-
Labridae																
<i>Thalassoma cupido</i> (Temminck & Schlegel, 1845)		T	235		14.4–81.5	12.5	37.5	37.5	75.0	91.7	232	12.5	-	-	25.0	3
<i>T. purpureum</i> (Forsskal, 1775)		T	14		14.6–75.9	-	-	12.5	-	8.3	2	12.5	12.5	25.0	25.0	12
<i>Halichoeres nebulosus</i> (Valenciennes, 1839)		AV	3		13.5–19.0	-	-	-	-	25.0	3	-	-	-	-	-
<i>Stethojulis bandanensis</i> (Bleeker, 1851)		AV	3		7.4–16.6	-	-	-	12.5	-	1	-	-	-	12.5	2
<i>Ha. marginatus</i> Rüppell, 1835		AV	2		13.7–20.4	-	-	-	12.5	-	1	-	-	-	12.5	1
<i>St. interrupta terina</i> Jordan & Snyder, 1902		AV	1		38.3	-	-	-	-	8.3	1	-	-	-	-	-
<i>T. amblycephalum</i> (Bleeker, 1856)		AV	1		19.4	-	-	-	12.5	-	1	-	-	-	-	-
Pomacentridae																
<i>Abudefduf sordidus</i> (Forsskal, 1775)		T	36		13.2–67.3	62.5	12.5	25.0	-	-	23	37.5	12.5	25.0	12.5	13
<i>A. notatus</i> (Day, 1870)		T	24		11.9–49.2	37.5	12.5	-	-	-	5	50.0	25.0	12.5	12.5	19
<i>Plectroglyphidodon leucozonus</i> (Bleeker, 1859)		T	15		15.9–84.4	-	-	12.5	-	58.3	12	-	-	-	25.0	3
<i>A. vaigiensis</i> (Quoy & Gaimard, 1825)		AV	6		12.7–22.0	-	-	-	12.5	25.0	6	-	-	-	-	-
<i>Chrysiptera brownriggii</i> (Bennett, 1828)		AV	6		16.9–58.2	-	-	-	-	16.7	5	-	-	-	12.5	1
<i>Chr. glauca</i> (Cuvier, 1830)		AV	2		16.8–64.0	-	-	-	-	-	-	-	-	-	12.5	2
Kyphosidae																
<i>Girella leonina</i> (Richardson, 1846)		T	15		15.9–109.8	37.5	-	12.5	-	-	7	25.0	12.5	-	-	8
<i>G. mezinga</i> Jordan & Starks, 1907		T	3		36.2–55.9	25.0	-	12.5	-	-	3	-	-	-	-	-
Scorpaenidae																
<i>Scorpaenodes guamensis</i> (Quoy & Gaimard, 1824)		T	11		15.2–45.9	12.5	-	-	37.5	33.3	10	-	-	-	12.5	1
<i>Parascorpaena mossambica</i> (Peters, 1855)		AV	4		16.6–26.1	-	-	-	-	16.7	4	-	-	-	-	-
<i>Sebastapistes strongia</i> (Cuvier, 1829)		AV	2		11.0–12.7	-	-	-	-	16.7	2	-	-	-	-	-
<i>Pterois radiata</i> Cuvier, 1829		AV	1		25.7	-	-	-	-	-	-	-	-	-	12.5	1
Gobiesocidae																
<i>Pherallodus indicus</i> (Weber, 1913)		T	13		9.0–21.9	-	-	-	25.0	25.0	12	-	-	-	12.5	1
<i>Lepadichthys frenatus</i> Waite, 1904		AV	3		9.7–19.3	-	-	-	12.5	16.7	3	-	-	-	-	-
<i>Conidens laticephalus</i> (Tanaka, 1909)		AV	1		10.7	-	-	-	-	8.3	1	-	-	-	-	-
Kuhliidae																
<i>Kuhlia mugil</i> (Forster, 1801)		T	10		17.1–39.2	25.0	25.0	-	-	8.3	8	12.5	12.5	-	-	2
Serranidae																
<i>Grammistes sexlineatus</i> (Thunberg, 1792)		AV	3		15.7–21.1	-	-	-	-	-	-	-	-	-	25.0	3
<i>Cephalopholis argus</i> Bloch & Schneider, 1801		AV	1		53.3	-	-	-	12.5	-	1	-	-	-	-	-
<i>Pogonoperca punctata</i> (Valenciennes, 1830)		AV	1		12.6	-	-	-	12.5	-	1	-	-	-	-	-
Syngnathidae																
<i>Choeroichthys sculptus</i> (Günther, 1870)		T	4		60.5–67.9	-	-	-	-	-	-	-	25.0	-	-	4
<i>Phoxocampus belcheri</i> (Kaup, 1856)		AV	1		28.1	-	-	-	-	8.3	1	-	-	-	-	-

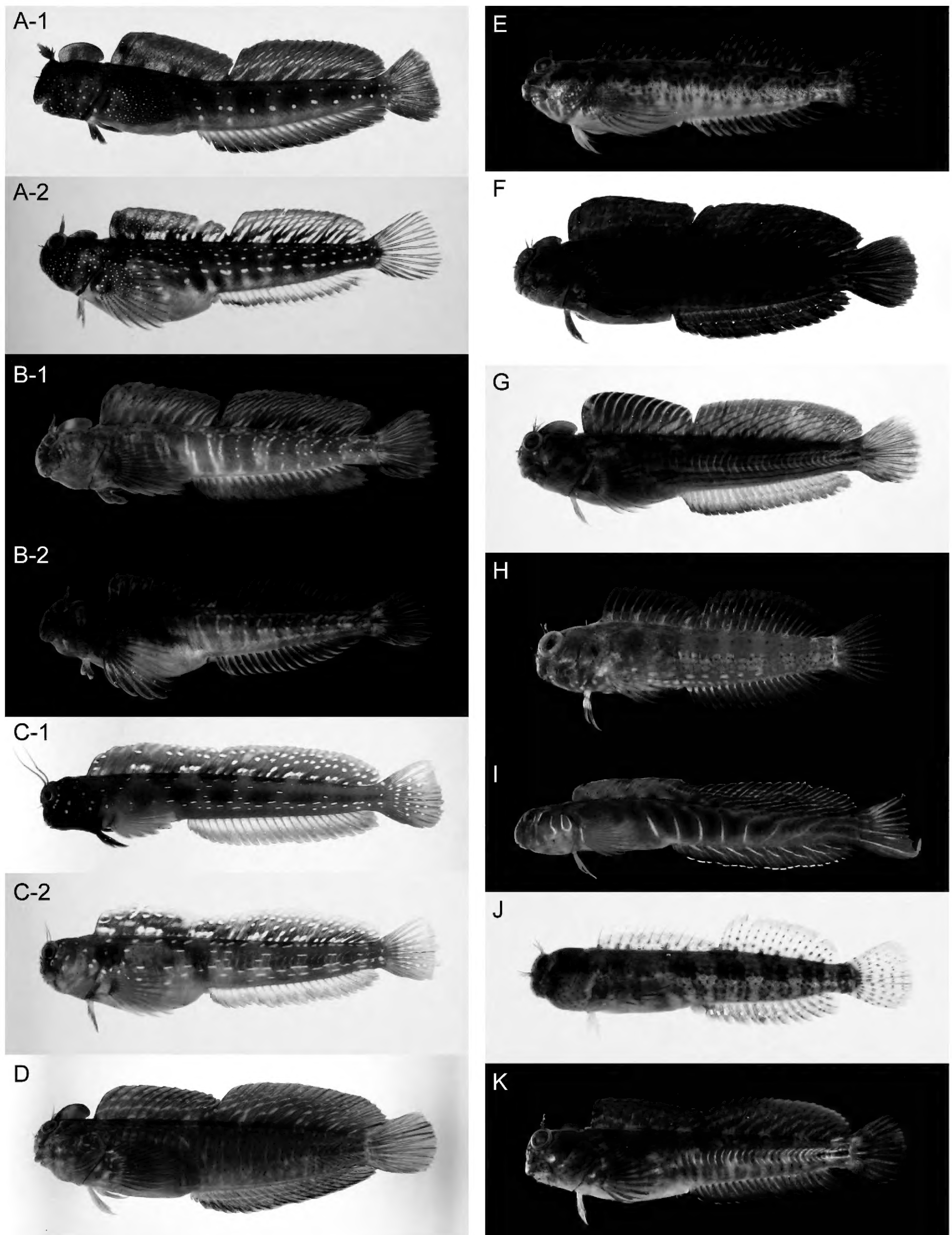
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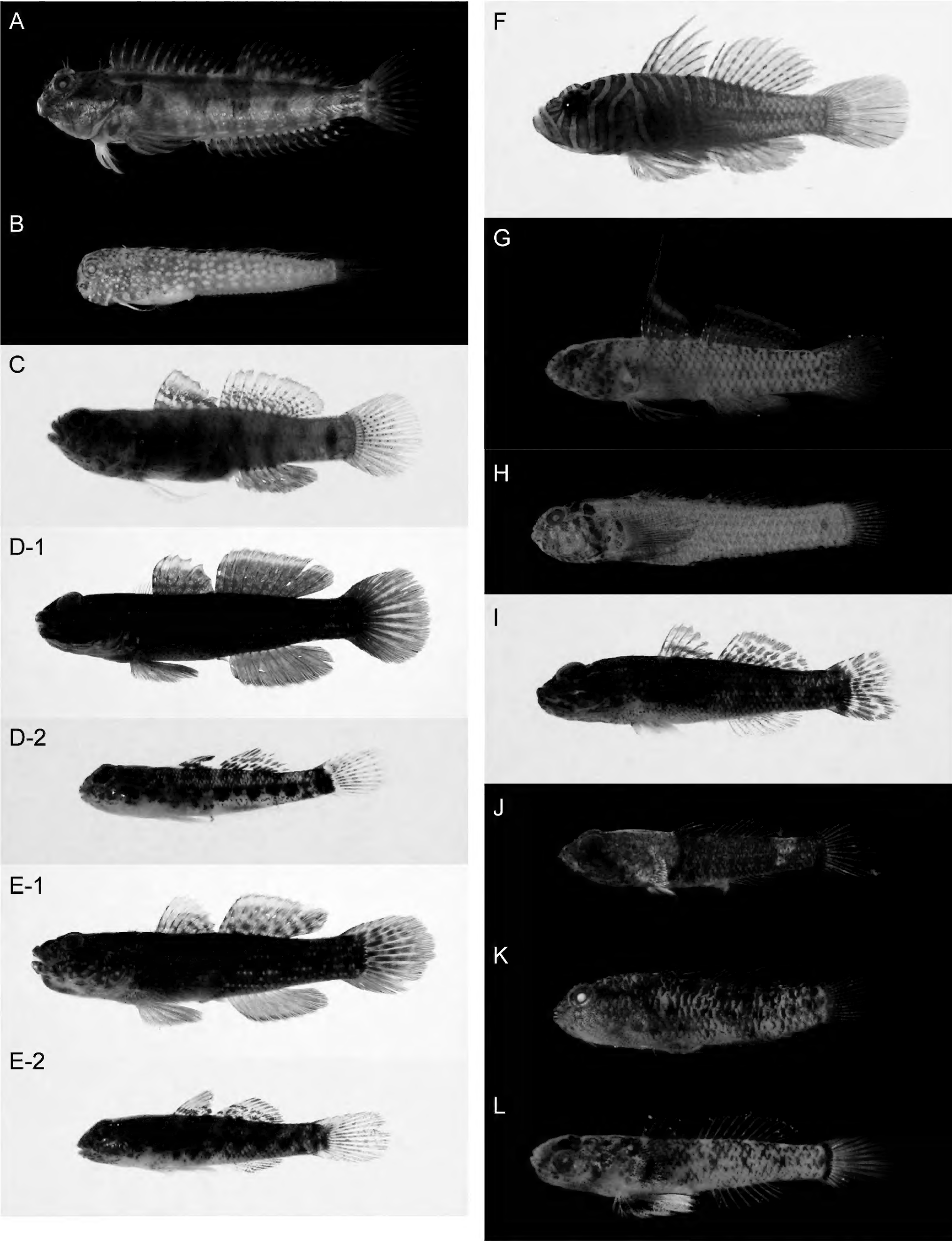
Family and species name	n	Life style status	SL (mm)	Term I (with exposed zone)					Term II (without exposed zone)					
				Vertical zone and occurrence rate (%)					Vertical zone and occurrence rate (%)					
				High	M high	M low	Low	Exposed	n	High	M high	M low	Low	n
Chaetodontidae														
<i>Chaetodon auripes</i> Jordan & Snyder, 1901	3	AV	20.2–29.4	12.5	-	-	-	16.7	3	-	-	-	-	-
<i>Cha. lunula</i> (Lacepède, 1802)	1	AV	30.0	-	-	12.5	-	-	1	-	-	-	-	-
Plesiopidae														
<i>Acanthoplesiops psilogaster</i> Hardy, 1985	3	AV	13.4–22.4	-	-	-	-	25.0	3	-	-	-	-	-
<i>Belonepterygion fasciolatum</i> (Ogilby, 1889)	1	AV	17.0	-	-	-	12.5	-	1	-	-	-	-	-
Antennariidae														
<i>Histrio histrio</i> (Linnaeus, 1758)	2	AV	9.0–15.0	-	-	12.5	12.5	-	2	-	-	-	-	-
Muraenidae														
<i>Gymnothorax chlorostigma</i> (Kaup, 1856)	2	AV	204.5–216.8*	-	-	-	-	16.7	2	-	-	-	-	-
Callionymidae														
<i>Neosynchiropus ocellatus</i> (Pallas, 1770)	1	AV	11.4	-	-	-	-	-	-	-	-	12.5	1	
Lutjanidae														
<i>Lutjanus stellatus</i> Akazaki, 1983	1	AV	23.0	-	-	12.5	-	-	1	-	-	-	-	-
Mullidae														
<i>Parupeneus</i> sp.	1	AV	34.2	12.5	-	-	-	-	1	-	-	-	-	-
Pomacanthidae														
<i>Pomacanthus semicirculatus</i> (Cuvier, 1831)	1	AV	21.9	-	-	-	-	8.3	1	-	-	-	-	-
Total number of species in each zone				19	15	18	30	41		16	15	12	26	
Total number of species in each term				64					34					

n , number of individual. -, absent. Life style status: AV, accidental visitor; R, resident; T, transient. Zone: High, higher ; M high, mid-higher; M low, mid-lower; Low, lower. \*Total length.



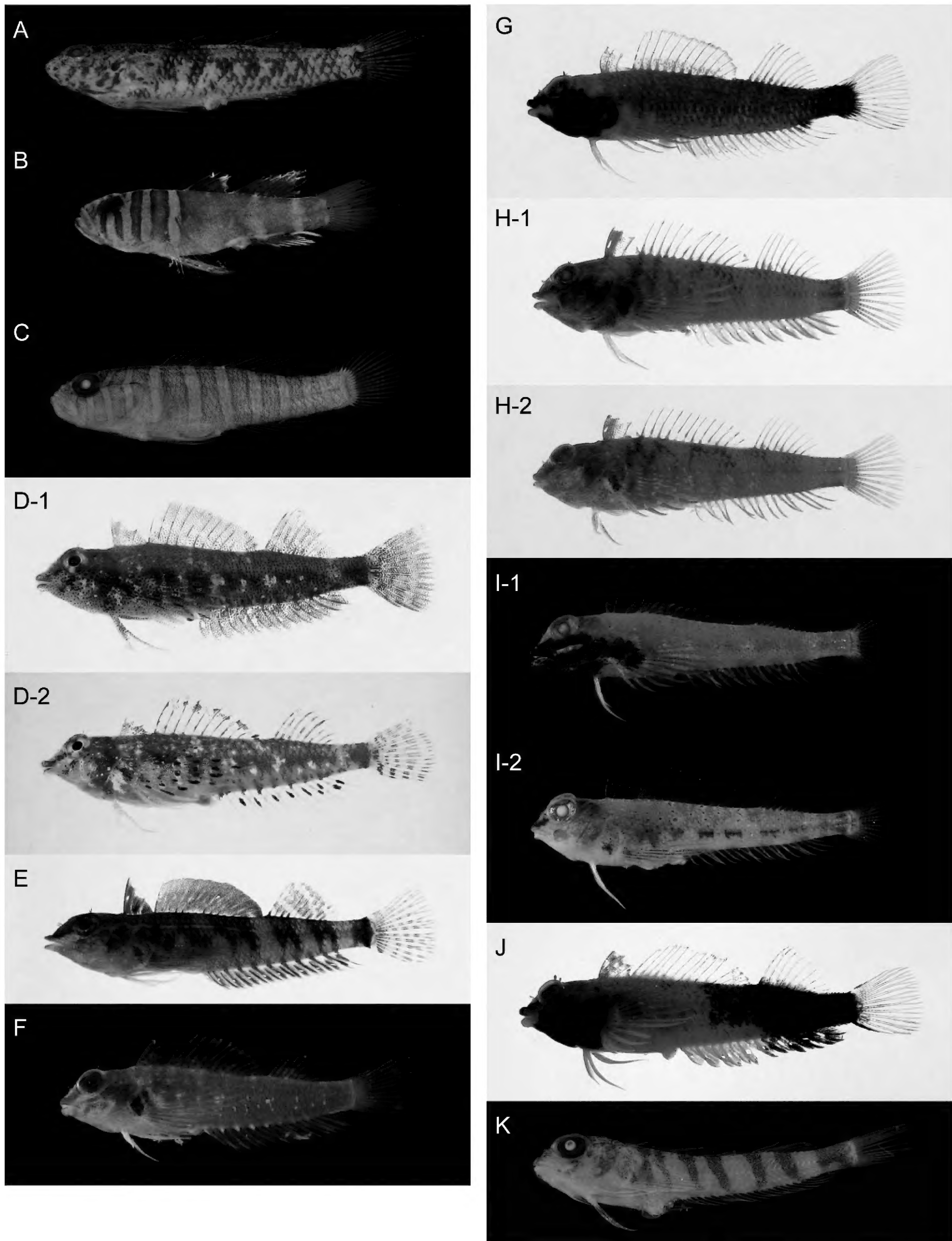


**Figure 3.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study, except for the specimens in images **A**, **B** and **C**, which were collected at Harutahama Beach, on the east coast of the island. **A**, *Praealticus bilineatus* (-1, male, KPM-NI22754, 43.9mmSL; -2, female, KPM-NI31454, 50.6 mm SL); **B**, *P. tanegasimae* (-1, male, KPM-NI22879, 64.9 mm SL; -2, female, KPM-NI31456, 61.2 mm SL); **C**, *Rhabdoblennius nitidus* (-1, male, KPM-NI22862, 45.9 mm SL; -2, female, KPM-NI31453, 52.3 mm SL); **D**, *Istiblennius edentulus*, KPM-NI30022, 93.6 mm SL; **E**, *Entomacrodus striatus*, KPM-NI29667, 42.1 mm SL; **F**, *I. enosimae*, KPM-NI30122, 94.1 mm SL; **G**, *I. lineatus*, KPM-NI30201, 54.2 mm SL; **H**, *Salarias sinuosus*, KPM-NI29844, 23.2 mm SL; **I**, *Omobranchus loxozonus*, KPM-NI30076, 49.5 mm SL; **J**, *E. thalassinus thalassinus*, KPM-NI24787, 30.5mmSL; **K**, *I. dussumieri*, KPM-NI30239, 40.9mmSL.

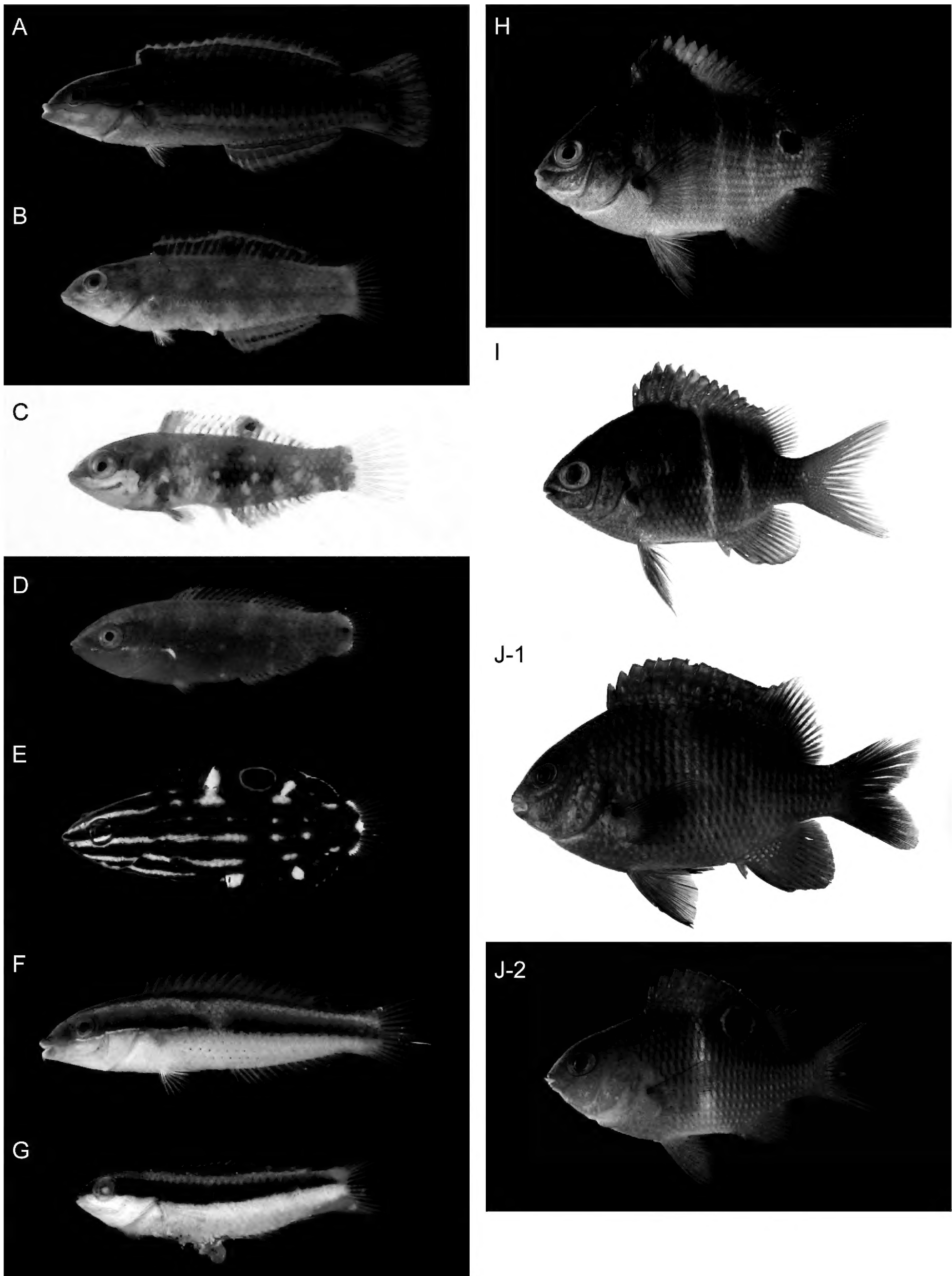


**Figure 4.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study. **A**, *Entomacrodus caudofasciatus*, KPM-NI24789, 35.3 mm SL; **B**, *Salarias luctuosus*, KPM-NI29868, 13.0 mm SL; **C**, *Eviota prasina*, KPM-NI29656, 21.7 mm SL; **D**, *Bathygobius cocosensis* (-1, mature individual, KPM-NI30189, 35.6 mm SL; -2, juvenile, KPM-NI30235, 14.7 mm SL); **E**, *B. coalitus* (-1, mature individual, KPM-NI29880, 45.7 mm SL; -2, juvenile, KPM-NI30234, 14.4mmSL); **F**, *Priolepis semidoliata*, KPM-NI29766, 19.2 mm SL; **G**, *E. abax*, KPM-NI29768, 21.6 mm SL; **H**, *E. japonica*, KPM-NI29716, 23.8 mm SL (preserved specimen); **I**, *B. cotticeps*, KPM-NI30068, 22.3 mm SL; **J**, *B. cyclopterus*, KPM-NI24908, 12.6 mm SL; **K**, *Asterropteryx semipunctata*, KPM-NI29865, 16.6 mm SL; **L**, *Cabillus tongarevae*, KPM-NI24793, 21.4 mm SL.

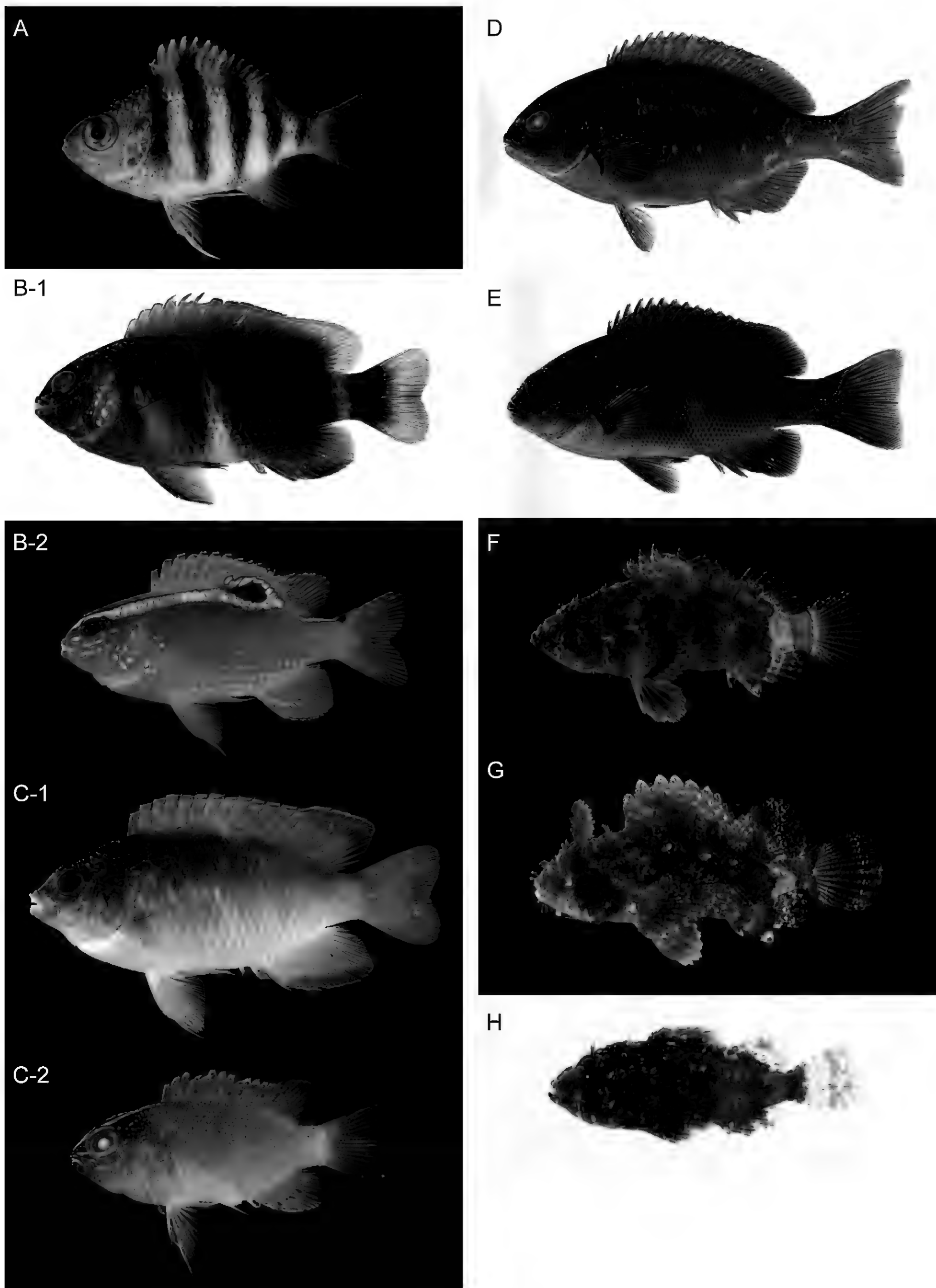




**Figure 5.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study, except for the specimens in images **D** and **E**, which were collected at Harutahama beach, on the east coast of the island. **A**, *Palutrus* cf. *reticularis*, KPM-NI30017, 17.0 mm SL (preserved specimen); **B**, *Priolepis borea*, KPM-NI29921, 10.4 mm SL; **C**, *Pr. cincta*, KPM-NI29859, 16.6 mm SL (preserved specimen); **D**, *Enneapterygius philippinus* (-1, male, KPM-NI22892, 21.9 mm SL; -2, female, KPM-NI22875, 27.8 mm SL); **E**, *E. etheostoma*, KPM-NI22782, 26.5 mm SL; **F**, *E. sp.* (*sensu* Meguro, 2013), KPM-NI29967, 19.7 mm SL; **G**, *E. leucopunctatus*, KPM-NI24790, 32.7 mm SL; **H**, *E. bahasa* (-1, dark color morph, KPM-NI24902, 24.1 mm SL; -2, pale color morph, KPM-NI29903, 24.3 mm SL); **I**, *Helcogramma fuscipectoris* (-1, male, KPM-NI29907, 23.5 mm SL; -2, female, KPM-NI29906, 23.9 mm SL); **J**, *E. hemimelas*, KPM-NI24781, 27.9 mm SL; **K**, *H. inclinatum*, KPM-NI29694, 14.8 mm SL (preserved specimen).

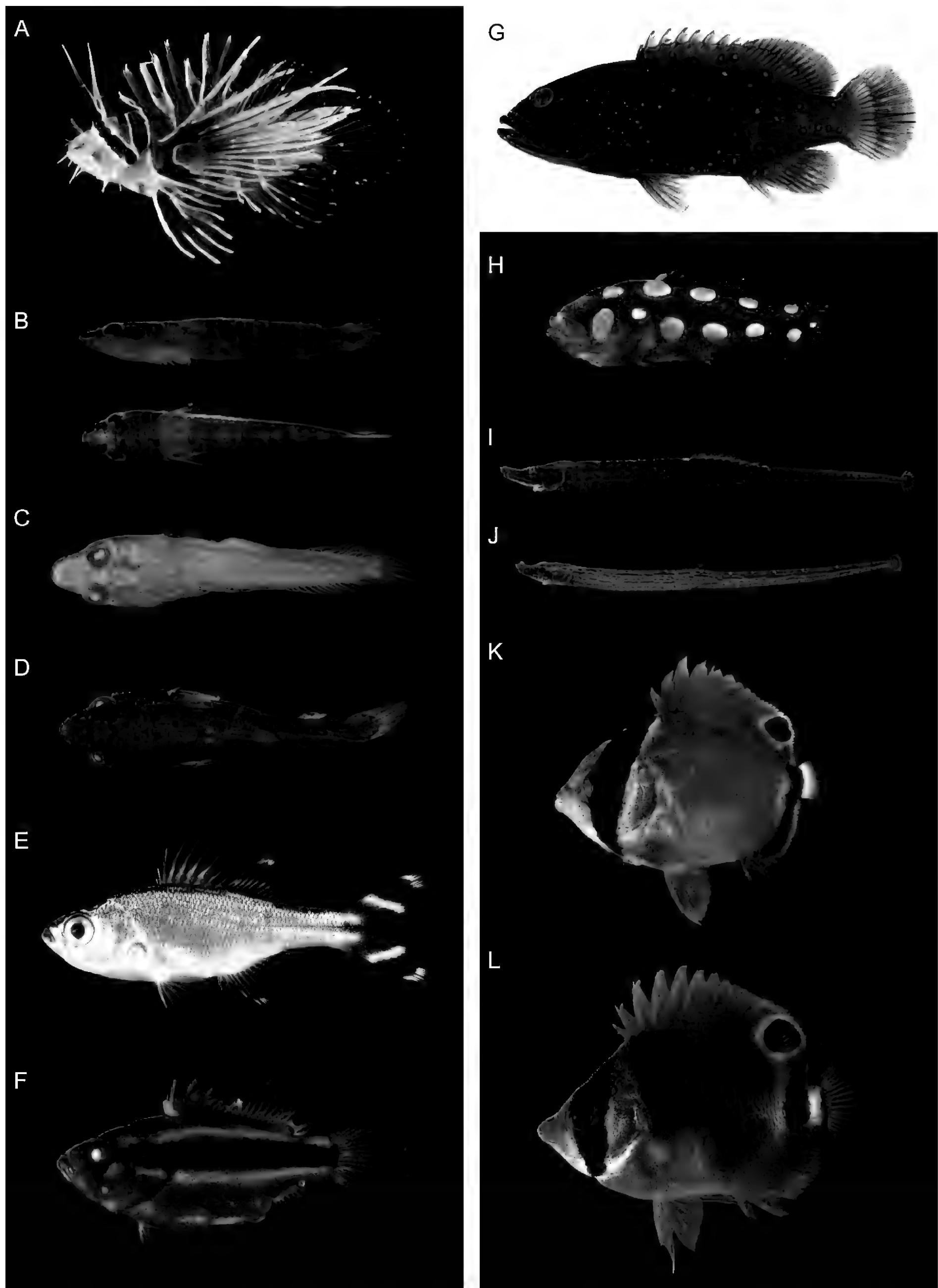


**Figure 6.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study. **A**, *Thalassoma cupido*, KPM-NI29888, 39.8 mm SL; **B**, *T. purpureum*, KPM-NI29969, 23.2 mm SL; **C**, *Halichoeres nebulosus*, KPM-NI30027, 19.0 mm SL; **D**, *Stethojulis bandanensis*, KPM-NI24792, 16.6 mm SL; **E**, *H. marginatus*, KPM-NI29923, 20.4 mm SL; **F**, *S. interrupta terina*, KPM-NI29773, 38.3 mm SL; **G**, *T. amblycephalum*, KPM-NI29864, 19.4 mm SL; **H**, *Abudefduf sordidus*, KPM-NI29878, 32.2 mm SL; **I**, *A. notatus*, KPM-NI30109, 34.4 mm SL; **J**, *Plectroglyphidodon leucozonus* (**-1**, adult, KPM-NI29966, 77.1 mm SL; **-2**, juvenile, KPM-NI29887, 27.2 mm SL).



**Figure 7.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study. **A**, *Abudefduf vaigiensis*, KPM-NI29925, 22.0 mm SL; **B**, *Crysiptera brownriggi* (-1, adult, KPM-NI24786, 58.2 mm SL; -2, juvenile, KPM-NI29843, 25.3 mm SL); **C**, *C. glauca* (-1, adult, KPM-NI30133, 64.0 mm SL; -2, juvenile, KPM-NI30134, 16.8 mm SL); **D**, *Girella leonina*, KPM-NI29708, 100.9 mm SL; **E**, *G. mezina*, KPM-NI29746, 55.9 mm SL; **F**, *Scorpaenodes guamensis*, KPM-NI29924, 19.4 mm SL; **G**, *Parascorpaena mossambica*, KPM-NI29774, 26.1 mm SL; **H**, *Sebastapistes strongia*, KPM-NI29769, 11.0 mm SL.





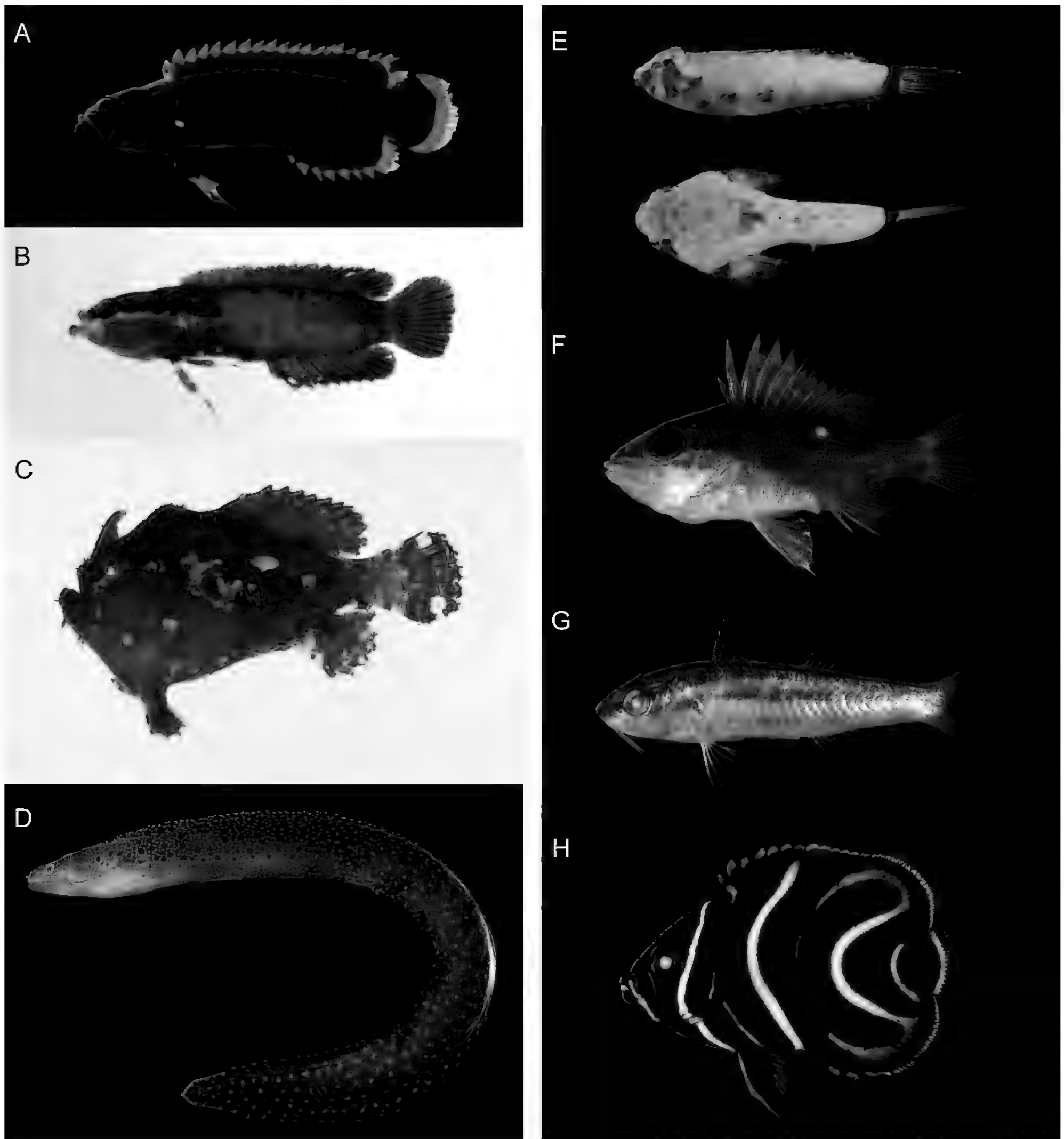
**Figure 8.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study. **A**, *Pterois radiata*, KPM-NI30096, 25.7 mm SL; **B**, *Pherallodus indicus*, KPM-NI29841, 13.7mm (upper, lateral view; lower, dorsal view); **C**, *Lepadichthys frenatus*, KPM-NI29682, 17.7 mm SL (preserved specimen); **D**, *Conidens laticephalus*, KPM-NI29537, 10.7 mm SL (preserved specimen); **E**, *Kuhlia mugil*, KPM-NI29752, 31.8 mm SL; **F**, *Grammistes sexlineatus*, KPM-NI30135, 21.1 mm SL; **G**, *Cephalopholis argus*, KPM-NI24784, 53.3 mm SL; **H**, *Pogonoperca punctata*, KPM-NI24799, 12.8 mm SL; **I**, *Choeroichthys sculptus*, KPM-NI24904, 60.5 mm SL; **J**, *Phoxocampus belcheri*, KPM-NI24796, 28.1 mm SL; **K**, *Chaetodon auripes*, KPM-NI29767, 20.3 mm SL; **L**, *C. lunula*, KPM-NI29747, 30.0 mm SL.

species), *B. coalitus* and *Priolepis semidoliata*, showed inverse tendencies in their vertical distribution with the former occurring more frequently in the higher zone and the latter occurring only in the lower and exposed zones. The predominant transients also had different vertical distribution patterns. *En. etheostoma*, *T. cupido* and *Plectroglyphidodon leucozonus* were more frequent in the lower rockpools, and a tripterygiid, *Enneapterygius* sp. occurred only in the exposed zone. In contrast,

*Abudefduf sordidus*, *A. notatus* and *Girella leonina*, were most frequently recorded at the higher zone.

## DISCUSSION

With the addition of the exposed zone category, 72 species were recorded in this study, which was a greater number than the 54 species of rockpool fish recorded in Murase (2013). Comparisons between these results and those from other regions of the world are listed



**Figure 9.** Color images of the rockpool fish from Yaku-shima Island. All photographed specimens were collected during this study. **A**, *Acanthoplesiops psilogaster*, KPM-NI29970, 17.2 mm SL; **B**, *Belonepterygion fasciolatum*, KPM-NI29633, 17.0 mm SL; **C**, *Histrio histrio*, KPM-NI24779, 15.0 mm SL; **D**, *Gymnothorax chlorostigma*, KPM-NI29900, 216.8 mm TL; **E**, *Neosynchiropus ocellatus*, KPM-NI24906, 11.4 mm SL (upper, lateral view; lower, dorsal view); **F**, *Lutjanus stellatus*, KPM-NI29748, 23.0 mm SL; **G**, *Parupeneus* sp., KPM-NI29736, 34.2 mm SL; **H**, *Pomacanthus semicirculatus*, KPM-NI29775, 21.9 mm SL.

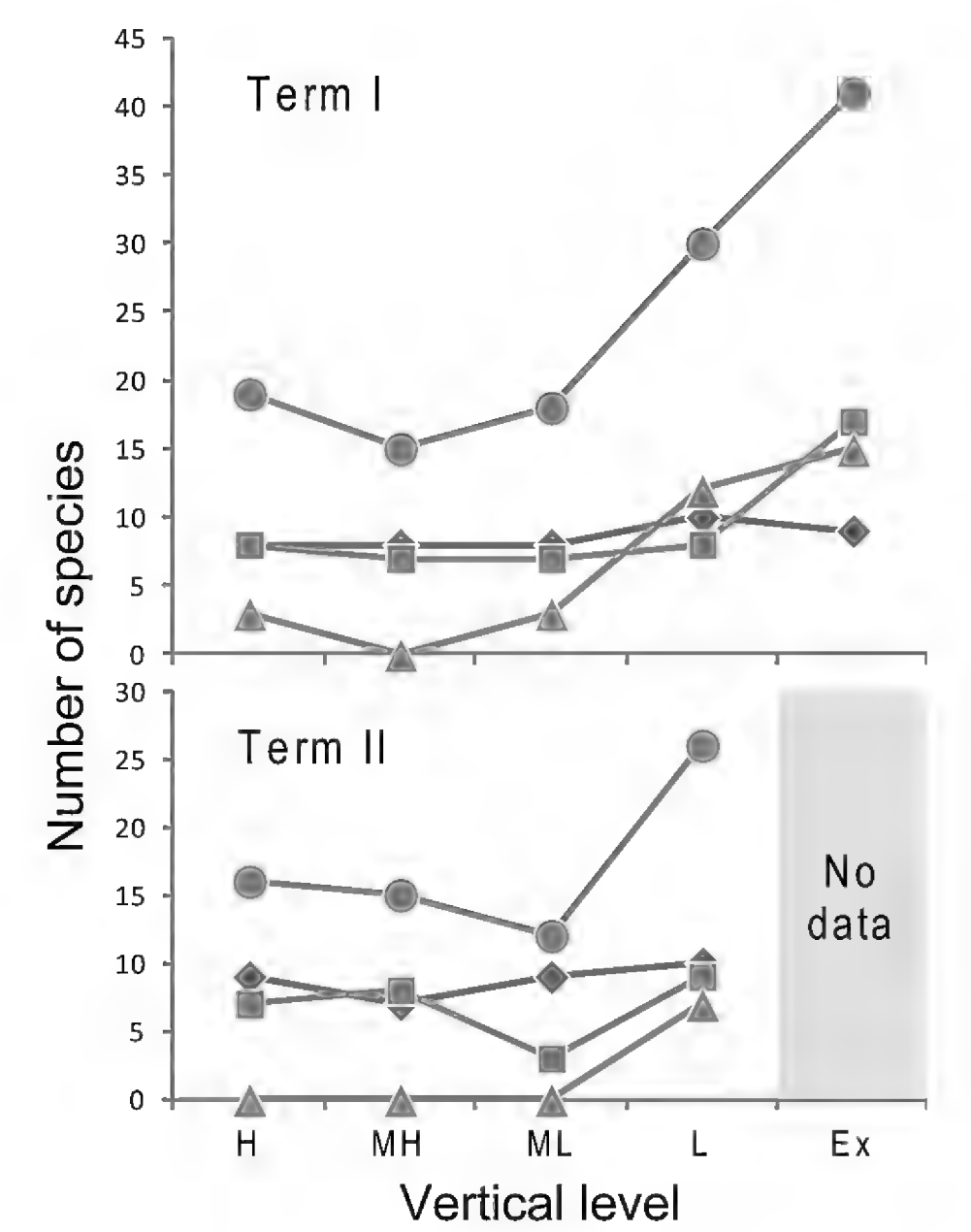
in Table 2. Gibson and Yoshiyama (1999) noted the potential effects of rockpool size on species richness in fish communities. In fact, species richness, numbers of individuals and biomass of each pool were positively associated with pool size (Mahon and Mahon 1994) and larger pools can permit permanency of schooling species (Macieira and Joyeux 2011). Therefore, studies targeting obviously large rockpools should be removed for regional comparison of species richness to avoid the bias arisen from large pool size. Some Taiwanese studies of rockpool fish communities recorded a large number of fish species (124–177) compared with other regions listed in Table 2 (Lee 1980a, b; Mok and Wen 1985). Lee (1980b) studied a large rockpool with a 400 m<sup>2</sup> surface area and 0.5–2.0 m in depth, and a number of subtidal species, such as muraenids, apogonids and labrids, and adult size of those species were captured from sites across Taiwan. So, those studies should not

**Table 2.** Variation of regional species richness in rockpool fish assemblages worldwide.

Region	Number of species	Source
<b>Indo-West Pacific</b>		
Central Japan	10–26	Arakaki and Tokeshi (2006), Murase et al. (2010), Okada et al. (in press)
Yaku-shima I., Southern Japan	72	This study
Taiwan	62–63	Chang et al. (1969)
Hawaii	19	Cox et al. (2011)
Southeastern Australia	23–50	Silberschneider and Booth (2001), Griffiths (2003a, b)
New Zealand	26	Willis and Roberts (1996)
Eastern South Africa	50	Beckly (2000)
<b>Eastern Pacific</b>		
Oregon, USA	8–10	Yoshiyama et al. (1986)
California, USA	8–29	Grossman (1982), Moring (1986), Yoshiyama et al. (1986)
El Salvador	19	González-Murcia et al. (2012)
Costa Rica	25–37	Weaver (1970)
Colombia	14	Castellanos-Galindo et al. (2005)
Central Chile	11–12	Varas and Ojeda (1990), Stepien (1990)
<b>Western Atlantic</b>		
Meine, USA	22	Moring (1990)
Massachusetts, USA	13	Collette (1986)
Florida, USA	45	Rummer et al. (2009)
Barbados	63	Mahon and Mahon (1994)
Northern Brazil	44	Rosa et al. (1997)
Southern Brazil	11–58	Barreiros et al. (2004), Macieira and Joyeux (2011), Macieira et al. (2015)
<b>Eastern Atlantic</b>		
Britain	20	Hussain and Knight-Jones (1995)
France	13	Gibson (1972)
Portugal	16	Arruda (1990)
<b>South Africa</b>		
Western South Africa	9–20	Bennett and Griffiths (1984), Prochazka and Griffiths (1992), Prochazka (1996)
Southern South Africa	16–35	Christensen and Winterbottom (1981), Bennett and Griffiths (1984), Beckley (1985), Bennett (1987)

be considered as true intertidal environment studies (Castellanos-Galindo et al. 2005; Murase 2013). Thomson and Lehner (1976) also investigated the fish assemblages of rockpools of a similar size to the Taiwanese study, in the Gulf of California. Lardner et al. (1993) recorded 99 fish species from a relatively large rockpool on the southeastern coast of Australia over 19 years, with the species richness not only reflecting the species diversity in that area of the world but also the rockpool size and long sampling duration (Griffiths 2003a, b). For these reasons, Table 2 does not contain the results of these studies mentioned above. Consequently, this study of the southwestern coast of Yaku-shima Island recorded the highest number rockpool fish species worldwide, to date (Table 2). These results agree with findings suggesting that the western Pacific region is generally considered a center of coastal fish diversity (Mora et al. 2003; Carpenter and Springer 2005; Tittensor et al. 2010), and even higher species richness of rockpool fish assemblages are likely to be recorded in future studies in the western Pacific region.

Although the total number of species did not differ between the higher and mid-lower zones, there was a



**Figure 10.** Spatial variation of the species richness for each life-style category (red circles, total of all categories; blue diamonds, residents; green squares, transients; yellow triangles, accidental visitors) in relation to the vertical height of pools. Abbreviations of x-axis: H, higher zone; MH, mid-higher zone; ML, mid-lower zone; L, lower zone; Ex, exposed zone. The upper and lower graphs show data from Terms I and II, respectively.



clear increase in species richness of accidental visitors, which led to an increase in the total number of species in the lower zone during both terms (Figure 10). At the exposed zone, the species richness of transients and accidental visitors increased maximally, resulting in the highest total number of species among the zones. A negative correlation between species richness of rockpool fish and vertical height has already been demonstrated (Castellanos-Galindo et al. 2005; Murase et al. 2010), and this could have been due to more occasional species entering the intertidal zone from the subtidal zone for feeding and/or to avoid predators (e.g. Black and Miller 1991; Rangeley and Kramer 1995a, b). The results of the present study supported this finding.

The results of this study showed the different vertical distribution patterns of the six most common species found in rockpools. Of the common blennioid species, *Praealticus tanegasimae* occurred more frequently in the higher zone and *Rhabdoblennius nitidus* occurred more frequently in the lower and exposed zones, whereas *P. bilineatus* showed a median distribution tendency between these two species (Table 1). These blennioids have similar feeding habits, feeding on algae and detritus (Hundt et al. 2014), but their different vertical distribution tendencies could moderate interspecific competition and allow them to predominantly inhabit intertidal zones at the same site. *Eviota prasina* showed a similar distribution pattern to *R. nitidus* but differs in its diet; *E. prasina* feeds predominantly on detritus and some invertebrates, and *R. nitidus* feeds mainly on algae (Murase, unpublished data). This difference in feeding habits may enable the coexistence of these two species. In contrast, *Bathygobius cocosensis* showed a uniform vertical distribution tendency at the study site, and its size distribution tends to be smaller in higher zone through two terms (Murase, unpublished data) suggesting the intraspecific competition (Gibson and Yoshiyama 1999; Zander et al. 1999). *Enneapterygius philippinus* was distributed throughout the lower zone, and this likely reflected its physical preference for a habitat that was closed and with a good water supply. The two resident gobies, *B. coalitus* and *Priolepis semidoliata*, occurred more frequently in the higher and lower pools, respectively. More detailed studies on the ecology of these species are needed to understand the mechanisms behind their distribution patterns in the intertidal zone.

Tidepool environments can act as temporal habitats for the different life-stages of fish in various regions (Gibson and Yoshiyama 1999; Murase et al. 2010; González-Murcia et al. 2012; Murase 2013), and a number of transient species were recorded in this study. These transients comprised two groups in terms of their vertical distribution pattern. First, *Thalassoma cupido*, *Enneapterygius etheostoma*, *Enneapterygius*

sp. and *Plectroglyphidodon leucozonus* occurred more frequently in the lower pools, suggesting their temporal use of the intertidal environment without intertidal adaptation, as mentioned in Zander et al. (1999). The other group containing *Abudefduf sordidus*, *A. notatus* and *Girella leonina* was in the higher pools, even though their adult forms generally inhabited the subtidal rocky shore (Masuda and Kobayashi 1994; Araga 1997). Small individuals of *A. sordidus* were recorded in higher rockpools than the congeneric *A. vaigiensis* on the Pacific coast of Japan (Eto et al. 2005), and the girellid, *G. elevata*, in southeastern Australia was recorded in the highest rockpools (1.4–1.8 m vertical height) by Griffiths et al. (2003). Physiological and/or behavioral characteristics adapted to an intertidal life may allow the juveniles of these transient species to inhabit these rockpool environments (Griffiths et al. 2003) and may moderate interspecific competition. The five transient tripterygiids that were recorded only in the exposed zone (*Enneapterygius* sp., *E. leucopunctatus*, *E. bahasa*, *Helcogramma fuscipectoris* and *E. hemimelas*; Table 1) were found at 10 or 20 m maximum depth in previous ichthyofaunal surveys in southern Japan (Motomura et al. 2013; Motomura and Matsuura 2014). The results of this study suggested that these tripterygiids also inhabited rockpool environments that were affected by the open sea.

In addition to a series of ichthyofaunal surveys (Motomura et al. 2010; Motomura and Aizawa 2011; Murase et al. 2011), this study updates the fish fauna of Yaku-shima Island with the following voucher specimens: Specimens of two gobiid species, *Palutrus* cf. *reticularis* (Figure 5A, KPM-NI 30017) and *Priolepis borea* (Figure 5B, KPM-NI 29921), representing the first record of this species on Yaku-shima Island, and the specimen of *P. borea* was the southernmost record of this species in Japanese waters (Akihito et al. 2013), although Murase (2013) listed this species he did not provide the voucher species information. A juvenile labrid specimen (KPM-NI 24797) identified as *Halichoeres margaritaceus* in Motomura et al. (2010) was herein re-identified as *Halichoeres nebulosus*, and that specimen, along with another (KPM-NI 29908, 30027), represent the first record of *H. nebulosus* as a voucher specimen at Yaku-shima Island, although they were previously known only from underwater photographs in Motomura et al. (2010).

## ACKNOWLEDGMENTS

I would like to express my sincere thanks to the following people who contributed to this study: Tomoki Sunobe (Tokyo University of Marine Science and Technology) for his help and advice during this study; Yusuke Miyazaki (Kanagawa Prefectural Museum), Masatoshi Meguro (Kagoshima University), and Mikio

Watai (National Research Institute of Far Seas Fisheries) who helped with the field sampling; Hiroshi Senou (Kanagawa Prefectural Museum) managed the voucher specimens, provided taxonomic information to identify the Labridae and Gobiidae, and took the photographs of the preserved specimens; Hiroyuki Motomura (Kagoshima University Museum) and Satokuni Tashiro (Kagoshima University) who provided taxonomic information to identify the scorpaenid and tripterygiid species, respectively; Rie Takahashi (Kanagawa Prefectural Museum) who managed the voucher specimens deposited in the museum; the staff of the Hydrographic and Oceanographic Department of the 10th Regional Coast Guard Headquarters (Kagoshima, Japan) who provided tidal information about the study site. I also thank two anonymous reviewers for their valuable comments on the manuscript. This study was partly supported by the Japan Society for the Promotion of Science (Research Fellowship for Young Scientists No. 21·6886 to A. Murase).

## LITERATURE CITED

- Akihito, K. Sakamoto, Y. Ikeda and M. Aizawa. 2013. Gobioidae; pp. 1347–1608, 2109–2211 in: T. Nakabo (ed.). Fishes of Japan with pictorial keys to the species, third edition. Hadano: Tokai University Press. (In Japanese).
- Araga, C. 1997. Pomacentridae; pp. 435–463, in: O. Okamura and K. Amaoka (eds.). Sea fishes of Japan. Tokyo: Yama-kei Publishers. (In Japanese).
- Arakaki, S. and M. Tokeshi. 2006. Short-term dynamics of tidepool fish community: diel and seasonal variation. *Environmental Biology of Fishes* 76(2–4): 221–235. doi: 10.1007/s10641-006-9024-5
- Arruda, L. M. 1990. Population structure of fish in the intertidal ranges of the Portuguese coasts. *Vie et Milieu* 40(4): 319–323.
- Barreiros, J. P., Á. Bertoncini, L. Machado, M. Hostim-Silva and R. Serrão-Santos. 2004. Diversity and seasonal changes in the ichthyofauna of rocky tidal pools from Praia Vermelha and São Roque, Santa Catarina. *Brazilian Archives of Biology and Technology* 47(2): 291–299. [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S1516-89132004000200017](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-89132004000200017)
- Beckley, L. M. 1985. Tide-pool fishes: recolonization after experimental elimination. *Journal of Experimental Marine Biology and Ecology* 85(3): 287–295. doi: 10.1016/0022-0981(85)90163-7
- Beckley, L. M. 2000. Species composition and recruitment of tidal pool fishes in KwaZulu-Natal, South Africa. *African Zoology* 35(1): 29–34. <http://africanzoology.journals.ac.za/pub/article/view/170/168>
- Bennett, B. A. and C. L. Griffiths. 1984. Factors affecting the distribution, abundance and diversity of rock-pool fishes on the Cape Peninsula, South Africa. *South African Journal of Zoology* 19(2): 97–104.
- Bennett, B. A. 1987. The rock-pool fish community of Koppie Alleen and an assessment of the importance of Cape rock-pools as nurseries for juvenile fish. South Africa. *South African Journal of Zoology* 22(1): 25–32.
- Black, R. and R. J. Miller. 1991. Use of the intertidal zone by fish in Nova Scotia. *Environmental Biology of Fishes* 31(2): 109–121. doi: 10.1007/BF00001010
- Carpenter, K. E. and V. G. Springer. 2005. The center of the center of marine shore fish biodiversity: the Philippine Islands. *Environmental Biology of Fishes* 72(4): 467–480. doi: 10.1007/s10641-004-3154-4
- Castellanos-Galindo, G. A., A. Giraldo and E. A. Rubio. 2005. Community structure of an assemblage of tidepool fishes on a tropical eastern Pacific rocky shore, Colombia. *Journal of Fish Biology* 67(2): 392–408. doi: 10.1111/j.0022-1112.2005.00735.x
- Chang, K.-H., S.-C. Lee and T.-S. Wang. 1969. A preliminary report of ecological study on some intertidal fishes of Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica* 8(1): 59–70.
- Christensen, M. S. and R. Winterbottom. 1981. A correction factor for, and its application to, visual censuses littoral fish. *South African Journal of Zoology* 16(2): 73–79.
- Collette, B. B. 1986. Resilience of the fish assemblage in New England tidepools. *Fishery Bulletin* 84(1): 200–204.
- Cox, T. E., E. Baumgartner, J. Philippoff and K. S. Boyle. 2011. Spatial and vertical patterns in the tidepool fish assemblage on the island of O’ahu. *Environmental Biology of Fishes* 90(4): 329–342. doi: 10.1007/s10641-010-9744-4
- Eto, Y., S. Ohnishi and I. Akagawa. 2005. Microhabitat selection by two tidepool-inhabiting congeneric pomacentrids, *Abudefduf sordidus* and *A. vaigiensis*. *Bulletin of Institute of Oceanic Research and Development, Tokai University* (26): 23–32. (In Japanese with English abstract).
- Gibson, R. N. and R. M. Yoshiyama. 1999. Intertidal fish communities; pp. 264–296, in: M. H. Horn, K. L. M. Martin and M. A. Chotkowski (eds.). *Intertidal fishes: life in two worlds*. San Diego, CA: Academic Press.
- Gibson, R. N. 1972. The vertical distribution and feeding relationships of intertidal fish on the Atlantic coast of France. *Journal of Animal Ecology* 41(1): 189–207. doi: 10.2307/3512
- González-Murcia, S., C. Marín-Martínez and A. Ayala-Bocos. 2012. Intertidal rockpool ichthyofauna of El Pital, La Libertad, El Salvador. *Check List* 8(6): 1216–1219. <http://www.checklist.org.br/getpdf?SL009-12>
- Griffiths, S. P. 2003a. Rockpool ichthyofaunas of temperate Australia: species composition, residency and biogeographic patterns. *Estuarine, Coastal and Shelf Science* 58(1): 173–186. doi:10.1016/S0272-7714(03)00073-8
- Griffiths, S. P. 2003b. Spatial and temporal dynamics of temperate Australian rockpool ichthyofaunas. *Marine and Freshwater Research* 54(2): 163–176. doi: 10.1071/MF02102
- Griffiths, S. P., R. J. West and A. R. Davis. 2003. Effects of intertidal elevation on the rockpool ichthyofaunas of temperate Australia. *Environmental Biology of Fishes* 68(2): 197–204. doi: 10.1023/B:EBFI.0000003870.76842.d0
- Grossman, G. D. 1982. Dynamics and organization of a rocky intertidal fish assemblage: the persistence and resilience of taxocene structure. *American Naturalist* 119(5): 611–637.
- Hundt, P. J., Y. Nakamura and K. Yamaoka. 2014. Diet of combtooth blennies (Blenniidae) in Kochi and Okinawa, Japan. *Ichthyological Research* 61(1): 76–82. doi: 10.1007/s10228-013-0366-7
- Hussain, N. A. and E. W. Knight-Jones. 1995. Fish and fish-leeches on rocky shores around Britain. *Journal of the Marine Biological Association of the United Kingdom* 75(2): 311–322. doi: 10.1017/S0025315400018191
- Lardner, R., W. Ivantsoff and L. E. L. M. Crowley. 1993. Recolonization by fishes of a rocky intertidal pool following repeated defaunation. *Australian Zoologist* 29(1–2): 86–92. doi: 10.7882/AZ.1993.008
- Lee, S.-C. 1980a. Intertidal fishes of a rocky pool of the Sanhsientai, eastern Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica* 19(1): 19–26.
- Lee, S.-C. 1980b. Intertidal fishes of the rocky pools at Lanyu (Botel Tobago), Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica* 19(2): 1–13.

- Macieira, R. M. and J.-C. Joyeux. 2011. Distribution patterns of tidepool fishes on a tropical flat reef. *Fishery Bulletin* 109(3): 305–315. <http://fishbull.noaa.gov/1093/macieira.pdf>
- Macieira, R. M., T. Simon, C. R. Pimentel and J.-C. Joyeux. 2015. Isolation and speciation of tidepool fishes as a consequence of Quaternary sea-level fluctuations. *Environmental Biology of Fishes* 98(1): 385–393. doi: 10.1007/s10641-014-0269-0
- Mahon, R. and S. D. Mahon. 1994. Structure and resilience of a tidepool fish assemblage at Barbados. *Environmental Biology of Fishes* 41(1–4): 171–190. doi: 10.1007/BF00023811
- Masuda, H. and Y. Kobayashi. 1994. *Grand atlas of fish life modes*. Tokyo: Tokai University Press. 465 pp. (In Japanese).
- Meguro, M. 2013. *Enneapterygius* sp.; pp 293–294, in: H. Motomura, S. Dewa, K. Furuta and K. Matsuura (eds). *Fishes of Iou-jima and Take-shima islands, Mishima, Kagoshima, Japan*. Kagoshima: The Kagoshima University Museum and Tsukuba: the National Museum of Nature and Science. (In Japanese).
- Mok, H.-K. and P.-Y. Wen. 1985. Intertidal fish community ecology on Lu Tao Island (Green Island), Taiwan. *Journal of Taiwan Museum* 38(1): 81–118.
- Mora, C., P. M. Chittaro, P. F. Sale, J. P. Kritzer and S. A. Ludsin. 2003. Patterns and processes in reef fish diversity. *Nature* 421(6926): 933–936. doi: 10.1038/nature01393
- Moring, J. R. 1986. Seasonal presence of tidepool fish species in a rocky intertidal zone of northern California, USA. *Hydrobiologia* 134(1): 21–27. doi: 10.1007/BF00008696
- Moring, J. R. 1990. Seasonal absence of fishes in tidepools of a boreal environment (Maine, USA). *Hydrobiologia* 194(2): 163–168. doi: 10.1007/BF00028417
- Motomura, H. 2014. *Scorpaenodes guamensis*; p. 124, in: H. Motomura, S. Dewa, K. Furuta and K. Matsuura (eds.). *Field guide to fishes of Yoron Island in the middle of the Ryukyu Islands, Japan*. Kagoshima: The Kagoshima University Museum and Tsukuba: The National Museum of Nature and Science. (In Japanese).
- Motomura, H. and M. Aizawa. 2011. Illustrated list of additions to the ichthyofauna of Yaku-shima Island, Kagoshima Prefecture, southern Japan: 50 new records from the island. *Check List* 7(4): 448–457. <http://www.checklist.org.br/getpdf?SL005-11>
- Motomura, H., S. Dewa, K. Furuta and K. Matsuura (eds.) 2013. *Fishes of Iou-jima and Take-shima islands, Mishima, Kagoshima, Japan*. Kagoshima: The Kagoshima University Museum and Tsukuba: the National Museum of Nature and Science. 390 pp. (In Japanese).
- Motomura, H., K. Kuriwa, E. Katayama, H. Senou, G. Ogihara, M. Meguro, M. Matsunuma, Y. Takata, T. Yoshida, M. Yamashita, S. Kimura, H. Endo, A. Murase, Y. Iwatsuki, Y. Sakurai, S. Harazaki, K. Hidaka, H. Izumi and K. Matsuura. 2010. Annotated checklist of marine and estuarine fishes of Yaku-shima Island, Kagoshima, southern Japan; pp. 65–247, in: H. Motomura and K. Matsuura (eds). *Fishes of Yaku-shima Island—a World Heritage island in the Osumi Group, Kagoshima Prefecture, southern Japan*. Tokyo: The National Museum of Nature and Science. <http://www.museum.kagoshima-u.ac.jp/staff/motomura/2010-03-checklist%20of%20fishes%20of%20Yaku-shima%20Island.pdf>
- Motomura, H. and K. Matsuura (eds.). 2014. *Field guide to fishes of Yoron Island in the middle of the Ryukyu Islands, Japan*. Kagoshima: The Kagoshima University Museum and Tsukuba: the National Museum of Nature and Science. 648 pp. (In Japanese).
- Murase, A. 2013. Community structure and short temporal stability of a rockpool fish assemblage at Yaku-shima Island, southern Japan, northwestern Pacific. *Ichthyological Research* 60(4): 312–326. doi: 10.1007/s10228-013-0351-1
- Murase, A., S. Harazaki, M. Meguro and H. Motomura. 2011. Northernmost records of three blennioid fishes (Teleostei: Perciformes) from Yaku-shima Island, southern Japan, with their ecological notes. *Bulletin of the Biogeographical Society of Japan* 66: 61–73. (In Japanese with English abstract).
- Murase, A., Y. Miyazaki, G. Okuyama, J. Kaiga, Y. Tazaki and T. Sunobe. 2010. A preliminary study of rockpool fish assemblage structure in Tateyama Bay, Boso Peninsula, Chiba, central Japan. *Bulletin of the Biogeographical Society of Japan* 65: 141–149. (In Japanese with English abstract).
- Nakabo, T. (ed.). 2013. *Fishes of Japan with pictorial keys to the species*, third edition. Hadano: Tokai University Press. 2428 pp. (In Japanese).
- Okada, T., K. Ishihara, A. Murase and T. Hino. [In press]. A latitudinal gradient in the biogeographic compositions of rock pool fish assemblages on the Pacific coast of central Japan: an examination of the influence of the Kuroshio Current. *Biogeography* 17.
- Prochazka, K. and C. L. Griffiths. 1992. The intertidal fish fauna of the west coast of South Africa—species, community and biogeographic patterns. *South African Journal of Zoology* 27(3): 115–120.
- Prochazka, K. 1996. Seasonal patterns in a temperate intertidal fish community on the west coast of South Africa. *Environmental Biology of Fishes* 45(2): 133–140. doi: 10.1007/BF00005226
- Rangeley, R. W. and D. L. Kramer. 1995a. Use of rocky intertidal habitats by juvenile pollock *Pollachius virens*. *Marine Ecology Progress Series* 126: 9–17. doi: 10.3354/meps126009
- Rangeley, R. W. and D. L. Kramer. 1995b. Tidal effects on habitat selection and aggregation by juvenile pollock *Pollachius virens* in the rocky intertidal zone. *Marine Ecology Progress Series* 126: 19–29. doi: 10.3354/meps126019
- Rosa, R. S., I. L. Rosa and L. A. Rocha. 1997. Diversidade da ictiofauna de poças de maré da praia do Cabo Branco, João Pessoa, Paraíba, Brasil. *Revista Brasileira de Zoologia* 14(1), 201–212. doi: 10.1590/S0101-81751997000100019
- Rummer, J. L., N. A. Fague, H. L. Jordan, B. N. Tiffany, K. J. Blansit, S. Galleher, A. Kirkpatrick, A. A. Kizlauskas, C. M. Pomory and W. A. Bennett. 2009. Physiological tolerance to hyperthermia and hypoxia and effects on species richness and distribution of rockpool fishes of Loggerhead Key, Dry Tortugas National Park. *Journal of Experimental Marine Biology and Ecology* 371(2): 155–162. doi: 10.1016/j.jembe.2009.01.015
- Silberschneider, V. and D. J. Booth. 2001. Resource use by *Enneapterygius rufopileus* and other rockpool fishes. *Environmental Biology of Fishes* 61(2): 195–204. doi: 10.1023/A:1011032514604
- Stepien, C. A. 1990. Population structure, diets and biogeographic relationships of a rocky intertidal fish assemblage in central Chile: high levels of herbivory in a temperate system. *Bulletin of Marine Science* 47(3): 598–612.
- Thomson, D. A. and C. E. Lehner. 1976. Resilience of a rocky intertidal fish community in a physical unstable environment. *Journal of Experimental Marine Biology and Ecology* 22(1): 1–29. doi: 10.1016/0022-0981(76)90106-4
- Tittensor, D. P., C. Mora, W. Jetz, H. K. Lotze, D. Ricard, E. Vanden Berghe and B. Worm. 2010. Global patterns and predictors of marine biodiversity across taxa. *Nature* 466(7310): 1098–1101. doi: 10.1038/nature09329
- Varas, E. and F. P. Ojeda. 1990. Intertidal fish assemblages of the central Chilean coast: diversity, abundance and trophic patterns. *Revista de Biología Marina* 25(2): 59–70.
- Weaver, P. L. 1970. Species diversity and ecology of tidepool fishes in three Pacific coastal areas of Costa Rica. *Revista de Biología Tropical* 17(2): 165–185.
- Willis, T. J. and C. D. Roberts. 1996. Recolonization and recruitment of fishes to intertidal rockpools at Wellington, New Zealand. *Environmental Biology of Fishes* 47(4): 329–343. doi: 10.1007/BF00005047
- Yoshiyama, R. M., C. Sassaman and R. N. Lea. 1986. Rocky intertidal fish communities of California: temporal and spatial variation. *Environmental Biology of Fishes* 17(1): 23–40. doi: 10.1007/BF00000398



Zander, C. D., J. Nieder and K. Martin. 1999. Vertical distribution patterns; pp. 26–53, in: M. H. Horn, K. L. M. Martin and M. A. Chotkowski (eds.). Intertidal fishes: life in two worlds. San Diego, CA: Academic Press.

**Received:** 26 February 2015

**Accepted:** 25 May 2015

**Academic editor:** Osmar J. Luiz

## APPENDIX

A catalogue of all specimens examined in this study, including the number of specimens recorded and their size ranges (SL or total length, TL) in parentheses, in the same order. The families were ordered following Nelson (2006) and species were listed alphabetically.

MURAENIDAE—*Gymnothorax chlorostigma*: KPM-NI29653 (1, 204.5 mm TL); KPM-NI29900 (1, 216.8 mm TL).

ANTENNARIIDAE—*Histrio histrio*: KPM-NI24779 (1, 15.0 mm SL); KPM-NI29601 (1, 9.0 mm SL).

SYNGNATHIDAE—*Choeroichthys sculptus*: KPM-NI24903 (1, 66.6 mm SL), KPM-NI24904 (1, 60.5 mm SL), KPM-NI30359 (2, 60.7–67.9 mm SL); *Phoxocampus belcheri*: KPM-NI24796 (1, 28.1 mm SL).

SCORPAENIDAE—*Parascorpaena mossambica*: KPM-NI24783 (1, 21.2 mm SL), KPM-NI29765 (1, 16.6 mm SL), KPM-NI29774 (1, 26.1 mm SL), KPM-NI29777 (1, 23.7 mm SL); *Pterois radiata*: KPM-NI30096 (1, 25.7 mm SL); *Scorpaenodes guamensis*: KPM-NI29670 (1, 45.9 mm SL), KPM-NI29687 (1, 37.5 mm SL), KPM-NI29824 (1, 19.8 mm SL), KPM-NI29837 (1, 16.3 mm SL), KPM-NI29866 (1, 16.0 mm SL), KPM-NI29919 (1, 17.0 mm SL), KPM-NI29922 (1, 15.2 mm SL), KPM-NI29924 (1, 19.4 mm SL), KPM-NI29986 (1, 20.2 mm SL), KPM-NI30009 (1, 21.8 mm SL), KPM-NI30325 (1, 21.0 mm SL); *Sebastapistes strongia*: KPM-NI29630 (1, 12.7 mm SL), KPM-NI29769 (1, 11.0 mm SL).

SERRANIDAE—*Cephalopholis argus*: KPM-NI24784 (1, 53.3 mm SL); *Grammistes sexlineatus*: KPM-NI30135 (1, 21.1 mm SL), KPM-NI30136 (1, 16.7 mm SL), KPM-NI30173 (1, 15.7 mm SL); *Pogonoperca punctata*: KPM-NI24799 (1, 12.6 mm SL).

PLESIOPIDAE—*Acanthoplesiops psilogaster*: KPM-NI29575 (1, 22.4 mm SL), KPM-NI29771 (1, 13.4 mm SL), KPM-NI29970 (1, 17.2 mm SL); *Belonepterygion fasciolatum*: KPM-NI29633 (1, 17.0 mm SL).

LUTJANIDAE—*Lutjanus stellatus*: KPM-NI29748 (1, 23.0 mm SL).

MULLIDAE—*Parupeneus* sp.: KPM-NI29736 (1, 34.2 mm SL).

KYPHOSIDAE—*Girella leonina*: KPM-NI29517 (4, 39.7–50.4 mm SL), KPM-NI29708 (1, 100.9 mm SL), KPM-NI29724 (1, 52.6 mm SL), KPM-NI29744 (1, 15.9 mm SL), KPM-NI30279 (1, 109.8 mm SL), KPM-NI30376 (5, 18.6–28.3 mm SL), KPM-NI30380 (2, 17.9–20.9 mm SL); *Girella mezzina*: KPM-NI29746 (1, 55.9 mm SL), KPM-NI30045 (1, 52.9 mm SL); KPM-NI37968 (1, 36.2 mm SL).

CHAETODONTIDAE—*Chaetodon auripes*: KPM-NI29542 (1, 20.2 mm SL), KPM-NI29767 (1, 20.3 mm SL), KPM-NI30020 (1, 29.4 mm SL); *Chaetodon lunula*: KPM-NI29747 (1, 30.0 mm SL).

POMACANTHIDAE—*Pomacanthus semicirculatus*: KPM-NI29775 (1, 21.9 mm SL).

KUHLIIDAE—*Kuhlia mugil*: KPM-NI29707 (1, 39.2 mm SL), KPM-NI29751 (1, 19.1 mm SL), KPM-NI29752 (1, 31.8 mm SL), KPM-NI29791 (3, 22.4–23.5 mm SL), KPM-NI29885 (1, 20.2 mm SL), KPM-NI29954 (1, 17.1 mm SL), KPM-NI30278 (1, 37.4 mm SL), KPM-NI30360 (1, 24.2 mm SL).

POMACENTRIDAE—*Abudefduf notatus*: KPM-NI29723 (1, 24.6 mm SL), KPM-NI29823 (1, 11.9 mm SL), KPM-NI29877 (1, 24.3 mm SL), KPM-NI30010 (1, 33.1 mm SL), KPM-NI30051 (2, 13.3–22.2 mm SL), KPM-NI30053 (2, 20.7–34.3 mm SL), KPM-NI30065 (1, 49.2 mm SL), KPM-NI30097 (1, 15.5 mm SL), KPM-NI30109 (1, 34.4 mm SL), KPM-NI30152 (2, 16.8–17.4 mm SL), KPM-NI30202 (3, 18.9–33.6 mm SL), KPM-NI30219 (2, 18.2–20.7 mm SL), KPM-NI30240 (1,

14.1 mm SL), KPM-NI30241 (1, 18.8 mm SL), KPM-NI30243 (1, 28.6 mm SL), KPM-NI30244 (4, 16.5–25.6 mm SL); *Abudefduf sordidus*: KPM-NI29516 (3, 36.2–43.9 mm SL), KPM-NI29528 (2, 43.0–67.3 mm SL), KPM-NI29737 (1, 19.2 mm SL), KPM-NI29743 (1, 13.2 mm SL), KPM-NI29745 (1, 39.4 mm SL), KPM-NI29878 (1, 32.2 mm SL), KPM-NI29886 (4, 18.4–25.8 mm SL), KPM-NI30021 (1, 27.6 mm SL), KPM-NI30043 (1, 16.6 mm SL), KPM-NI30052 (7, 17.8–31.1 mm SL), KPM-NI30054 (1, 20.9 mm SL), KPM-NI30110 (1, 15.5 mm SL), KPM-NI30142 (1, 25.0 mm SL), KPM-NI30153 (3, 18.1–22.1 mm SL), KPM-NI30203 (1, 25.0 mm SL), KPM-NI30218 (1, 15.9 mm SL), KPM-NI30220 (4, 18.2–36.2 mm SL), KPM-NI30275 (1, 39.2 mm SL); *Abudefduf vaigiensis*: KPM-NI29541 (3, 12.7–16.5 mm SL), KPM-NI29792 (1, 14.9 mm SL), KPM-NI29925 (1, 22.0 mm SL), KPM-NI30028 (1, 20.9 mm SL). *Chrysiptera brownriggii*: KPM-NI24785 (1, 38.3 mm SL), KPM-NI24786 (1, 58.2 mm SL), KPM-NI29590 (1, 16.9 mm SL), KPM-NI29843 (1, 25.3 mm SL), KPM-NI29845 (1, 24.5 mm SL), KPM-NI30174 (1, 26.4 mm SL); *Chrysiptera glauca*: KPM-NI30133 (1, 64.0 mm SL), KPM-NI30134 (1, 16.8 mm SL); *Plectroglyphidodon leucozonus*: KPM-NI29654 (1, 79.1 mm SL), KPM-NI29655 (1, 81.8 mm SL), KPM-NI29669 (1, 47.2 mm SL), KPM-NI29688 (1, 84.4 mm SL), KPM-NI29842 (1, 15.9 mm SL), KPM-NI29887 (1, 27.2 mm SL), KPM-NI29904 (1, 73.4 mm SL), KPM-NI29909 (1, 25.8 mm SL), KPM-NI29966 (1, 77.1 mm SL), KPM-NI29976 (2, 24.4–37.3 mm SL), KPM-NI29978 (1, 84.0 mm SL), KPM-NI30141 (1, 36.8 mm SL), KPM-NI30176 (2, 36.8–38.2 mm SL).

LABRIDAE—*Halichoeres marginatus*: KPM-NI24905 (1, 13.7 mm SL), KPM-NI29923 (1, 20.4 mm SL); *Halichoeres nebulosus*: KPM-NI24797 (1, 13.5 mm SL), KPM-NI29908 (1, 14.5 mm SL), KPM-NI30027 (1, 19.0 mm SL); *Stethojulis bandanensis*: KPM-NI24792 (1, 16.6 mm SL), KPM-NI30137 (1, 14.9 mm SL), KPM-NI30140 (1, 7.4 mm SL); *Stethojulis interrupta terina*: KPM-NI29773 (1, 38.3 mm SL); *Thalassoma amblycephalum*: KPM-NI29864 (1, 19.4 mm SL); *Thalassoma cupido*: KPM-NI29529 (1, 29.5 mm SL), KPM-NI29543 (14, 15.2–30.9 mm SL), KPM-NI29554 (7, 15.3–37.6 mm SL), KPM-NI29560 (2, 21.5–27.4 mm SL), KPM-NI29572 (13, 14.7–34.7 mm SL), KPM-NI29591 (34, 14.8–45.4 mm SL), KPM-NI29602 (14, 15.0–32.4 mm SL), KPM-NI29611 (2, 26.6–35.9 mm SL), KPM-NI29631 (13, 14.5–26.8 mm SL), KPM-NI29644 (13, 15.3–31.4 mm SL), KPM-NI29665 (6, 17.4–36.5 mm SL), KPM-NI29671 (1, 40.6 mm SL), KPM-NI29672 (1, 28.9 mm SL), KPM-NI29673 (1, 20.7 mm SL), KPM-NI29676 (1, 15.1 mm SL), KPM-NI29685 (22, 14.4–34.6 mm SL), KPM-NI29698 (29, 14.9–35.4 mm SL), KPM-NI29717 (2, 18.0–28.2 mm SL), KPM-NI29735 (12, 15.4–31.0 mm SL), KPM-NI29764 (1, 36.9 mm SL), KPM-NI29838 (1, 48.6 mm SL), KPM-NI29860 (1, 31.4 mm SL), KPM-NI29888 (1, 39.8 mm SL), KPM-NI29895 (4, 29.7–51.9 mm SL), KPM-NI29920 (27, 30.8–81.5 mm SL), KPM-NI29941 (1, 27.2 mm SL), KPM-NI29977 (5, 33.1–49.0 mm SL), KPM-NI29987 (1, 51.4 mm SL), KPM-NI30039 (2, 36.6–58.3 mm SL), KPM-NI30077 (1, 23.5 mm SL), KPM-NI30177 (1, 50.8 mm SL), KPM-NI30204 (1, 19.8 mm SL); *Thalassoma purpuraceum*: KPM-NI29618 (1, 36.5 mm SL), KPM-NI29969 (1, 23.2 mm SL), KPM-NI30066 (1, 75.9 mm SL), KPM-NI30297 (1, 14.6 mm SL), KPM-NI30314 (2, 22.6–30.6 mm SL), KPM-NI30326 (1, 39.0 mm SL), KPM-NI30327 (4, 22.3–29.6 mm SL), KPM-NI30352 (2, 14.6–23.5 mm SL), KPM-NI30361 (1, 23.4 mm SL).

TRIPTERYGIIDAE—*Enneapterygius bahasa*: KPM-NI24902 (1, 24.1 mm SL), KPM-NI29574 (1, 32.1 mm SL), KPM-NI29623 (7, 28.5–31.7 mm SL), KPM-NI29624 (2, 29.9–31.2 mm SL), KPM-NI29681 (1, 14.1 mm SL), KPM-NI29903 (1, 24.3 mm SL), KPM-NI29914 (1, 21.0 mm SL), KPM-NI37745 (1, 21.9 mm SL); *Enneapterygius etheostoma*: KPM-NI29522 (5, 18.9–22.1 mm SL), KPM-NI29535 (4, 14.9–22.1 mm SL), KPM-NI29549 (1, 18.3 mm SL), KPM-NI29582 (1, 19.1 mm SL), KPM-NI29638 (5, 14.4–20.3 mm SL), KPM-NI29730 (8, 12.2–17.2 mm SL), KPM-NI29758 (23, 21.3–29.6 mm SL), KPM-NI29785 (3, 23.6–26.8 mm SL), KPM-NI29829 (1, 23.7 mm SL), KPM-NI29871 (1, 23.9 mm SL), KPM-NI29934 (1, 21.8 mm SL), KPM-NI29981 (2, 21.6–23.6 mm SL), KPM-NI30100 (1, 26.6 mm SL), KPM-NI30331 (1, 40.7 mm

SL); ***Enneapterygius hemimelas***: KPM-NI24781 (1, 27.9 mm SL), KPM-NI24800 (1, 20.8 mm SL); ***Enneapterygius hemimelas* or *E. leucopunctatus***: KPM-NI29573 (1, 31.6 mm SL), KPM-NI29584 (8, 13.6–32.7 mm SL), KPM-NI29854 (1, 19.4 mm SL), KPM-NI29901 (1, 24.6 mm SL), KPM-NI29968 (1, 23.0 mm SL), KPM-NI37743 (1, 30.7 mm SL); ***Enneapterygius leucopunctatus***: KPM-NI24782 (1, 31.3 mm SL), KPM-NI24790 (1, 32.7 mm SL), KPM-NI29852 (2, 21.7–24.8 mm SL), KPM-NI29853 (7, 19.6–24.9 mm SL), KPM-NI29913 (12, 17.8–24.4 mm SL), KPM-NI29983 (3, 18.8–23.7 mm SL), KPM-NI37742 (1, 30.1 mm SL); ***Enneapterygius philippinus***: KPM-NI29523 (3, 26.3–27.7 mm SL), KPM-NI29536 (1, 27.3 mm SL), KPM-NI29550 (6, 26.2–27.9 mm SL), KPM-NI29551 (5, 25.9–27.3 mm SL), KPM-NI29566 (7, 25.3–28.5 mm SL), KPM-NI29567 (7, 24.8–26.9 mm SL), KPM-NI29597 (5, 26.8–28.9 mm SL), KPM-NI29598 (3, 26.9–27.9 mm SL), KPM-NI29639 (2, 26.2–27.6 mm SL), KPM-NI29640 (2, 26.5–26.6 mm SL), KPM-NI29651 (1, 26.5 mm SL), KPM-NI29661 (2, 26.4–26.7 mm SL), KPM-NI29662 (5, 25.5–28.4 mm SL), KPM-NI29705 (2, 27.5–29.1 mm SL), KPM-NI29731 (4, 26.0–28.0 mm SL), KPM-NI29732 (9, 25.9–29.8 mm SL), KPM-NI29759 (1, 21.5 mm SL), KPM-NI29760 (1, 21.7 mm SL), KPM-NI29786 (1, 26.4 mm SL), KPM-NI29787 (2, 20.7–25.6 mm SL), KPM-NI29811 (7, 21.6–23.2 mm SL), KPM-NI29812 (4, 19.2–29.0 mm SL), KPM-NI29830 (2, 22.9–24.0 mm SL), KPM-NI29831 (2, 22.5–27.2 mm SL), KPM-NI29872 (3, 22.2–23.7 mm SL), KPM-NI29873 (1, 28.3 mm SL), KPM-NI29874 (3, 20.0–22.1 mm SL), KPM-NI29935 (10, 20.8–27.5 mm SL), KPM-NI29936 (6, 19.0–23.3 mm SL), KPM-NI29961 (1, 21.8 mm SL), KPM-NI29962 (1, 23.0 mm SL), KPM-NI29996 (1, 20.6 mm SL), KPM-NI30034 (5, 21.7–22.7 mm SL), KPM-NI30035 (5, 20.6–22.5 mm SL), KPM-NI30081 (7, 13.5–25.0 mm SL), KPM-NI30101 (1, 21.7 mm SL), KPM-NI30146 (3, 23.3–23.7 mm SL), KPM-NI30182 (1, 24.7 mm SL), KPM-NI30194 (3, 22.7–23.6 mm SL), KPM-NI30282 (2, 23.6–25.5 mm SL), KPM-NI30307 (2, 28.0–29.0 mm SL); ***Enneapterygius* sp. (sensu Meguro, 2013)**: KPM-NI29583 (6, 12.9–28.9 mm SL), KPM-NI29621 (5, 27.0–28.7 mm SL), KPM-NI29622 (6, 11.5–29.5 mm SL), KPM-NI29686 (1, 11.1 mm SL), KPM-NI29693 (5, 14.9–29.2 mm SL), KPM-NI29851 (1, 17.3 mm SL), KPM-NI29902 (1, 23.1 mm SL), KPM-NI29911 (14, 16.4–23.0 mm SL), KPM-NI29912 (6, 19.7–21.1 mm SL), KPM-NI29967 (1, 19.7 mm SL), KPM-NI29982 (1, 20.4 mm SL), KPM-NI37744 (1, 11.9 mm SL); ***Enneapterygius* unidentified species**: KPM-NI29626 (3, 12.0–14.4 mm SL), KPM-NI29627 (1, 11.2 mm SL); ***Helcogramma fuscipectoris***: KPM-NI29585 (1, 29.4 mm SL), KPM-NI29625 (2, 16.2–28.6 mm SL), KPM-NI29905 (1, 23.8 mm SL), KPM-NI29906 (1, 23.9 mm SL), KPM-NI29907 (1, 23.5 mm SL), KPM-NI29915 (2, 22.8–22.9 mm SL); ***Helcogramma inclinatum***: KPM-NI29568 (1, 14.3 mm SL), KPM-NI29694 (1, 14.8 mm SL).

BLENNIIDAE—***Blenniidae* unidentified species**: KPM-NI30123 (1, 16.8 mm SL); ***Entomacrodus caudofasciatus***: KPM-NI24789 (1, 35.3 mm SL); ***Entomacrodus striatus***: KPM-NI29576 (1, 69.6 mm SL), KPM-NI29581 (3, 48.6–67.0 mm SL), KPM-NI29620 (1, 61.6 mm SL), KPM-NI29667 (1, 42.1 mm SL), KPM-NI29668 (1, 51.6 mm SL), KPM-NI29674 (1, 62.0 mm SL), KPM-NI29675 (1, 71.3 mm SL), KPM-NI29680 (2, 41.7–69.4 mm SL), KPM-NI29850 (1, 32.1 mm SL), KPM-NI29910 (1, 16.5 mm SL), KPM-NI29972 (1, 15.3 mm SL), KPM-NI29980 (1, 32.0 mm SL); ***Entomacrodus thalassinus thalassinus***: KPM-NI24787 (1, 30.5 mm SL), KPM-NI24788 (1, 35.5 mm SL); ***Istiblennius dussumieri***: KPM-NI30237 (1, 33.5 mm SL), KPM-NI30239 (1, 40.9 mm SL); ***Istiblennius edentulus***: KPM-NI29513 (1, 47.6 mm SL), KPM-NI29521 (1, 36.1 mm SL), KPM-NI29861 (1, 40.4 mm SL), KPM-NI29862 (1, 65.7 mm SL), KPM-NI29882 (1, 48.2 mm SL), KPM-NI29942 (1, 33.5 mm SL), KPM-NI30011 (1, 42.0 mm SL), KPM-NI30012 (1, 39.3 mm SL), KPM-NI30022 (1, 93.6 mm SL), KPM-NI30040 (1, 28.1 mm SL), KPM-NI30041 (1, 30.5 mm SL), KPM-NI30042 (1, 22.7 mm SL), KPM-NI30044 (1, 23.9 mm SL), KPM-NI30058 (1, 70.5 mm SL), KPM-NI30063 (1, 75.6 mm SL), KPM-NI30102 (1, 60.4 mm SL), KPM-NI30175 (1, 56.7 mm SL), KPM-NI30181 (1, 100.8 mm SL), KPM-NI30190 (1, 64.1 mm SL),

KPM-NI30208 (1, 46.2 mm SL), KPM-NI30226 (1, 46.0 mm SL), KPM-NI30248 (2, 32.8–45.3 mm SL), KPM-NI30272 (1, 50.3 mm SL), KPM-NI30299 (1, 50.2 mm SL), KPM-NI30338 (2, 27.0–42.5 mm SL), KPM-NI30349 (1, 27.6 mm SL); ***Istiblennius edentulus* or *I. enosimae***: KPM-NI29534 (1, 39.1 mm SL), KPM-NI29565 (2, 31.6–38.9 mm SL), KPM-NI29740 (1, 18.5 mm SL), KPM-NI29770 (1, 17.2 mm SL), KPM-NI29772 (1, 19.8 mm SL), KPM-NI29784 (2, 29.4–37.9 mm SL), KPM-NI29809 (1, 19.0 mm SL), KPM-NI29828 (1, 21.1 mm SL), KPM-NI29927 (1, 19.1 mm SL), KPM-NI30004 (2, 24.0–36.6 mm SL), KPM-NI30057 (1, 55.0 mm SL), KPM-NI30082 (2, 17.2–26.2 mm SL), KPM-NI30209 (1, 18.6 mm SL), KPM-NI30225 (2, 50.3–54.8 mm SL), KPM-NI30308 (1, 37.2 mm SL); ***Istiblennius enosimae***: KPM-NI29632 (1, 91.3 mm SL), KPM-NI29729 (1, 53.5 mm SL), KPM-NI29820 (1, 28.8 mm SL), KPM-NI29926 (1, 84.2 mm SL), KPM-NI29988 (1, 79.3 mm SL), KPM-NI30062 (1, 82.5 mm SL), KPM-NI30122 (1, 94.1 mm SL), KPM-NI30138 (1, 55.4 mm SL), KPM-NI30193 (2, 58.4–104.7 mm SL), KPM-NI30217 (1, 39.8 mm SL); ***Istiblennius lineatus***: KPM-NI ( mm SL), KPM-NI ( mm SL); ***Omobranchus loxozonus***: KPM-NI29548 (1, 43.5 mm SL), KPM-NI29810 (3, 42.1–48.8 mm SL), KPM-NI30076 (1, 49.5 mm SL); ***Praealticus bilineatus***: KPM-NI29512 (1, 60.4 mm SL), KPM-NI29519 (7, 38.0–58.6 mm SL), KPM-NI29532 (4, 42.0–54.5 mm SL), KPM-NI29544 (10, 35.5–60.3 mm SL), KPM-NI29545 (13, 37.4–52.4 mm SL), KPM-NI29557 (1, 39.1 mm SL), KPM-NI29558 (2, 34.4–48.0 mm SL), KPM-NI29561 (17, 34.7–75.4 mm SL), KPM-NI29562 (22, 32.4–56.3 mm SL), KPM-NI29593 (5, 41.0–56.6 mm SL), KPM-NI29594 (5, 42.5–56.1 mm SL), KPM-NI29606 (2, 43.0–49.8 mm SL), KPM-NI29613 (5, 39.9–44.4 mm SL), KPM-NI29614 (2, 41.4–43.8 mm SL), KPM-NI29634 (10, 38.4–63.0 mm SL), KPM-NI29635 (21, 30.4–50.7 mm SL), KPM-NI29647 (3, 34.9–64.7 mm SL), KPM-NI29648 (2, 35.5–38.8 mm SL), KPM-NI29657 (4, 41.4–49.4 mm SL), KPM-NI29658 (9, 34.6–54.6 mm SL), KPM-NI29677 (1, 40.5 mm SL), KPM-NI29689 (3, 46.9–51.0 mm SL), KPM-NI29690 (1, 49.9 mm SL), KPM-NI29701 (9, 34.6–46.8 mm SL), KPM-NI29702 (12, 41.0–55.5 mm SL), KPM-NI29725 (26, 40.3–75.3 mm SL), KPM-NI29726 (57, 36.0–63.9 mm SL), KPM-NI29755 (2, 13.3–14.1 mm SL), KPM-NI29781 (2, 57.6–60.2 mm SL), KPM-NI29782 (3, 40.1–53.9 mm SL), KPM-NI29783 (1, 16.4 mm SL), KPM-NI29803 (1, 46.3 mm SL), KPM-NI29804 (1, 43.9 mm SL), KPM-NI29805 (1, 17.4 mm SL), KPM-NI29816 (3, 41.5–60.8 mm SL), KPM-NI29817 (1, 39.3 mm SL), KPM-NI29818 (3, 12.0–24.1 mm SL), KPM-NI29825 (7, 44.1–57.9 mm SL), KPM-NI29826 (6, 41.1–49.6 mm SL), KPM-NI29827 (1, 24.9 mm SL), KPM-NI29869 (2, 47.8–54.5 mm SL), KPM-NI29891 (3, 40.8–56.3 mm SL), KPM-NI29928 (3, 44.0–48.7 mm SL), KPM-NI29929 (13, 39.5–55.0 mm SL), KPM-NI29930 (3, 15.6–32.0 mm SL), KPM-NI29945 (3, 44.9–47.0 mm SL), KPM-NI29946 (2, 41.7–47.2 mm SL), KPM-NI29947 (2, 13.7–23.4 mm SL), KPM-NI29955 (1, 36.6 mm SL), KPM-NI29956 (7, 40.7–49.1 mm SL), KPM-NI29957 (6, 14.4–27.9 mm SL), KPM-NI29989 (5, 46.3–53.2 mm SL), KPM-NI29990 (12, 38.8–57.2 mm SL), KPM-NI29991 (4, 15.1–30.8 mm SL), KPM-NI30029 (2, 49.9–51.0 mm SL), KPM-NI30030 (5, 39.8–49.6 mm SL), KPM-NI30059 (1, 59.6 mm SL), KPM-NI30071 (4, 39.7–70.0 mm SL), KPM-NI30072 (14, 35.9–62.8 mm SL), KPM-NI30073 (8, 25.7–31.5 mm SL), KPM-NI30086 (5, 39.0–50.5 mm SL), KPM-NI30087 (1, 63.4 mm SL), KPM-NI30088 (10, 13.3–32.7 mm SL), KPM-NI30092 (2, 40.7–44.3 mm SL), KPM-NI30093 (10, 14.6–33.8 mm SL), KPM-NI30106 (7, 41.0–68.8 mm SL), KPM-NI30107 (7, 35.6–49.3 mm SL), KPM-NI30108 (9, 20.1–29.6 mm SL), KPM-NI30115 (8, 38.0–58.0 mm SL), KPM-NI30116 (7, 46.7–53.5 mm SL), KPM-NI30117 (13, 20.5–38.1 mm SL), KPM-NI30130 (8, 39.0–54.1 mm SL), KPM-NI30131 (6, 35.2–53.9 mm SL), KPM-NI30132 (23, 24.6–36.1 mm SL), KPM-NI30150 (3, 39.1–53.2 mm SL), KPM-NI30151 (2, 37.8–47.0 mm SL), KPM-NI30161 (7, 39.7–58.0 mm SL), KPM-NI30162 (7, 34.4–52.3 mm SL), KPM-NI30163 (4, 25.1–31.1 mm SL), KPM-NI30169 (1, 50.9 mm SL), KPM-NI30170 (4, 39.3–48.1 mm SL), KPM-NI30171 (4, 30.6–36.0 mm SL), KPM-NI30186 (9, 39.7–62.1 mm SL), KPM-NI30187 (2, 37.6–53.2 mm SL), KPM-NI30188 (12, 23.0–37.5 mm SL), KPM-NI30198 (7,



41.1–52.9 mm SL), KPM-NI30199 (6, 35.3–54.4 mm SL), KPM-NI30200 (7, 26.0–35.5 mm SL), KPM-NI30210 (2, 46.5–59.8 mm SL), KPM-NI30211 (8, 41.7–56.0 mm SL), KPM-NI30212 (8, 22.7–39.4 mm SL), KPM-NI30216 (1, 23.5 mm SL), KPM-NI30227 (3, 41.6–50.3 mm SL), KPM-NI30228 (11, 37.9–58.9 mm SL), KPM-NI30229 (4, 29.9–38.7 mm SL), KPM-NI30249 (1, 46.8 mm SL), KPM-NI30270 (1, 59.5 mm SL), KPM-NI30271 (4, 44.6–64.5 mm SL), KPM-NI30276 (4, 40.7–51.4 mm SL), KPM-NI30286 (2, 48.1–52.7 mm SL), KPM-NI30287 (6, 39.4–52.4 mm SL), KPM-NI30288 (2, 33.2–33.7 mm SL), KPM-NI30293 (2, 36.0–38.8 mm SL), KPM-NI30294 (3, 36.1–51.5 mm SL), KPM-NI30302 (4, 40.7–51.7 mm SL), KPM-NI30303 (1, 36.5 mm SL), KPM-NI30304 (2, 29.9–34.1 mm SL), KPM-NI30312 (1, 53.0 mm SL), KPM-NI30316 (7, 39.2–52.0 mm SL), KPM-NI30317 (4, 35.0–53.6 mm SL), KPM-NI30323 (6, 39.9–60.7 mm SL), KPM-NI30324 (2, 47.5–53.7 mm SL), KPM-NI30334 (6, 38.3–57.0 mm SL), KPM-NI30335 (4, 36.0–45.1 mm SL), KPM-NI30341 (3, 41.8–50.2 mm SL), KPM-NI30342 (7, 38.2–51.2 mm SL), KPM-NI30343 (4, 31.2–35.3 mm SL), KPM-NI30344 (1, 55.5 mm SL), KPM-NI30345 (1, 50.5 mm SL), KPM-NI30346 (2, 33.1–42.9 mm SL), KPM-NI30353 (1, 39.7 mm SL), KPM-NI30354 (1, 40.9 mm SL), KPM-NI30355 (1, 36.6 mm SL), KPM-NI30364 (1, 53.2 mm SL), KPM-NI30365 (2, 45.9–48.7 mm SL), KPM-NI30372 (3, 41.0–48.6 mm SL), KPM-NI30373 (2, 32.4–35.8 mm SL); ***Praealticus tanegasimae***: KPM-NI29511 (11, 52.8–79.3 mm SL), KPM-NI29518 (14, 37.6–83.4 mm SL), KPM-NI29530 (2, 62.7–72.7 mm SL), KPM-NI29531 (12, 43.3–62.3 mm SL), KPM-NI29555 (1, 55.7 mm SL), KPM-NI29556 (1, 43.6 mm SL), KPM-NI29592 (1, 70.4 mm SL), KPM-NI29603 (8, 49.9–77.6 mm SL), KPM-NI29604 (15, 43.5–67.9 mm SL), KPM-NI29612 (1, 52.9 mm SL), KPM-NI29645 (7, 49.7–80.2 mm SL), KPM-NI29646 (6, 46.7–62.1 mm SL), KPM-NI29699 (1, 56.7 mm SL), KPM-NI29700 (1, 55.6 mm SL), KPM-NI29709 (19, 41.1–74.0 mm SL), KPM-NI29710 (16, 41.5–60.2 mm SL), KPM-NI29718 (25, 35.7–78.3 mm SL), KPM-NI29719 (20, 35.0–58.0 mm SL), KPM-NI29738 (11, 37.0–70.4 mm SL), KPM-NI29739 (11, 41.3–61.0 mm SL), KPM-NI29749 (14, 55.4–79.1 mm SL), KPM-NI29750 (26, 51.1–76.2 mm SL), KPM-NI29753 (2, 58.0–72.0 mm SL), KPM-NI29754 (5, 40.1–64.7 mm SL), KPM-NI29778 (6, 51.3–77.6 mm SL), KPM-NI29779 (2, 50.8–52.4 mm SL), KPM-NI29780 (2, 30.2–33.2 mm SL), KPM-NI29819 (1, 12.2 mm SL), KPM-NI29883 (3, 50.3–65.6 mm SL), KPM-NI29889 (2, 52.0–58.4 mm SL), KPM-NI29890 (2, 49.1–53.2 mm SL), KPM-NI29943 (6, 33.1–72.0 mm SL), KPM-NI29944 (6, 41.1–50.3 mm SL), KPM-NI29999 (1, 59.1 mm SL), KPM-NI30001 (22, 37.4–77.5 mm SL), KPM-NI30002 (12, 43.4–53.4 mm SL), KPM-NI30003 (7, 26.9–36.9 mm SL), KPM-NI30013 (17, 40.4–70.0 mm SL), KPM-NI30014 (6, 40.6–61.9 mm SL), KPM-NI30015 (1, 32.7 mm SL), KPM-NI30046 (6, 34.9–60.0 mm SL), KPM-NI30047 (11, 40.3–62.4 mm SL), KPM-NI30060 (4, 57.7–75.1 mm SL), KPM-NI30061 (3, 63.4–74.0 mm SL), KPM-NI30069 (12, 32.7–83.0 mm SL), KPM-NI30070 (7, 29.1–42.6 mm SL), KPM-NI30094 (1, 33.7 mm SL), KPM-NI30095 (1, 33.0 mm SL), KPM-NI30113 (1, 50.3 mm SL), KPM-NI30114 (2, 57.9–64.6 mm SL), KPM-NI30155 (3, 33.5–74.6 mm SL), KPM-NI30156 (27, 45.1–68.9 mm SL), KPM-NI30164 (2, 47.8–48.0 mm SL), KPM-NI30213 (12, 38.7–70.5 mm SL), KPM-NI30214 (14, 40.5–62.8 mm SL), KPM-NI30215 (34, 25.8–40.5 mm SL), KPM-NI30230 (12, 35.8–78.6 mm SL), KPM-NI30231 (8, 34.6–55.2 mm SL), KPM-NI30250 (12, 41.0–76.4 mm SL), KPM-NI30251 (12, 39.1–62.7 mm SL), KPM-NI30252 (4, 27.0–37.9 mm SL), KPM-NI30268 (4, 52.6–80.3 mm SL), KPM-NI30269 (8, 48.5–73.5 mm SL), KPM-NI30295 (5, 44.7–69.0 mm SL), KPM-NI30296 (5, 40.2–74.5 mm SL), KPM-NI30310 (9, 44.5–89.6 mm SL), KPM-NI30311 (22, 50.0–71.9 mm SL), KPM-NI30318 (1, 57.9 mm SL), KPM-NI30366 (11, 41.2–78.3 mm SL), KPM-NI30367 (12, 40.6–65.2 mm SL), KPM-NI30368 (10, 30.3–39.4 mm SL), KPM-NI30369 (8, 38.2–75.6 mm SL), KPM-NI30370 (8, 42.5–61.9 mm SL), KPM-NI30371 (1, 34.8 mm SL), KPM-NI30377 (3, 41.7–64.8 mm SL), KPM-NI30378 (6, 43.2–59.8 mm SL), KPM-NI30379 (1, 35.0 mm SL); ***Rhabdoblennius nitidus***: KPM-NI29520 (2, 46.2–49.5 mm SL), KPM-NI29533 (1, 50.2 mm SL),

KPM-NI29546 (9, 29.2–60.8 mm SL), KPM-NI29547 (14, 30.6–60.4 mm SL), KPM-NI29563 (4, 38.3–47.7 mm SL), KPM-NI29564 (4, 34.5–47.6 mm SL), KPM-NI29577 (5, 42.4–55.7 mm SL), KPM-NI29578 (12, 36.0–54.2 mm SL), KPM-NI29595 (3, 55.5–63.7 mm SL), KPM-NI29596 (5, 38.0–55.4 mm SL), KPM-NI29607 (2, 45.9–55.4 mm SL), KPM-NI29608 (1, 46.2 mm SL), KPM-NI29615 (2, 53.0–55.1 mm SL), KPM-NI29619 (1, 41.1 mm SL), KPM-NI29636 (4, 38.0–52.4 mm SL), KPM-NI29637 (4, 37.2–50.6 mm SL), KPM-NI29649 (2, 36.7–48.4 mm SL), KPM-NI29650 (6, 37.4–49.6 mm SL), KPM-NI29659 (18, 31.7–59.2 mm SL), KPM-NI29660 (3, 34.8–39.2 mm SL), KPM-NI29678 (3, 43.3–51.3 mm SL), KPM-NI29679 (6, 39.8–50.9 mm SL), KPM-NI29691 (8, 38.1–61.9 mm SL), KPM-NI29692 (3, 39.3–44.0 mm SL), KPM-NI29703 (8, 31.4–57.0 mm SL), KPM-NI29704 (2, 40.8–52.5 mm SL), KPM-NI29711 (1, 57.6 mm SL), KPM-NI29720 (1, 53.6 mm SL), KPM-NI29727 (20, 31.1–59.1 mm SL), KPM-NI29728 (40, 31.2–53.4 mm SL), KPM-NI29756 (1, 58.7 mm SL), KPM-NI29757 (1, 16.4 mm SL), KPM-NI29793 (1, 12.0 mm SL), KPM-NI29794 (1, 11.8 mm SL), KPM-NI29795 (1, 14.0 mm SL), KPM-NI29796 (1, 15.7 mm SL), KPM-NI29797 (1, 17.0 mm SL), KPM-NI29806 (6, 43.7–58.7 mm SL), KPM-NI29807 (4, 34.3–53.7 mm SL), KPM-NI29808 (14, 14.5–33.1 mm SL), KPM-NI29846 (6, 44.6–57.7 mm SL), KPM-NI29847 (1, 40.9 mm SL), KPM-NI29848 (1, 28.0 mm SL), KPM-NI29849 (1, 13.4 mm SL), KPM-NI29870 (3, 49.5–70.0 mm SL), KPM-NI29892 (1, 40.9 mm SL), KPM-NI29896 (4, 27.9–51.5 mm SL), KPM-NI29897 (4, 44.8–55.6 mm SL), KPM-NI29931 (2, 45.0–46.9 mm SL), KPM-NI29932 (5, 41.0–52.8 mm SL), KPM-NI29933 (3, 20.8–25.9 mm SL), KPM-NI29948 (2, 40.6–43.6 mm SL), KPM-NI29949 (1, 20.2 mm SL), KPM-NI29958 (4, 41.2–57.1 mm SL), KPM-NI29959 (2, 45.4–55.1 mm SL), KPM-NI29960 (11, 14.5–29.3 mm SL), KPM-NI29971 (1, 44.1 mm SL), KPM-NI29979 (3, 39.7–54.0 mm SL), KPM-NI29992 (3, 40.6–49.7 mm SL), KPM-NI29993 (7, 38.1–49.6 mm SL), KPM-NI29994 (9, 14.8–28.9 mm SL), KPM-NI29995 (2, 12.2–12.4 mm SL), KPM-NI30025 (1, 12.4 mm SL), KPM-NI30031 (17, 39.6–65.9 mm SL), KPM-NI30032 (12, 36.7–50.4 mm SL), KPM-NI30033 (61, 12.4–33.0 mm SL), KPM-NI30083 (8, 38.1–62.6 mm SL), KPM-NI30084 (12, 33.2–52.5 mm SL), KPM-NI30085 (9, 16.0–28.7 mm SL), KPM-NI30090 (1, 55.8 mm SL), KPM-NI30091 (1, 33.1 mm SL), KPM-NI30103 (4, 37.6–49.8 mm SL), KPM-NI30104 (3, 38.2–39.1 mm SL), KPM-NI30105 (5, 23.1–32.2 mm SL), KPM-NI30118 (1, 49.3 mm SL), KPM-NI30119 (3, 37.5–50.0 mm SL), KPM-NI30120 (6, 23.0–33.1 mm SL), KPM-NI30127 (4, 36.4–42.2 mm SL), KPM-NI30128 (5, 31.6–42.7 mm SL), KPM-NI30129 (15, 12.6–30.7 mm SL), KPM-NI30147 (2, 36.0–36.3 mm SL), KPM-NI30148 (5, 36.0–61.9 mm SL), KPM-NI30149 (2, 25.2–28.1 mm SL), KPM-NI30159 (1, 39.7 mm SL), KPM-NI30160 (1, 34.3 mm SL), KPM-NI30167 (3, 33.4–38.0 mm SL), KPM-NI30168 (3, 25.8–29.8 mm SL), KPM-NI30183 (4, 36.3–56.5 mm SL), KPM-NI30184 (3, 37.5–39.2 mm SL), KPM-NI30185 (4, 29.1–33.0 mm SL), KPM-NI30195 (3, 38.0–45.9 mm SL), KPM-NI30196 (2, 37.3–48.4 mm SL), KPM-NI30197 (12, 17.5–34.9 mm SL), KPM-NI30283 (3, 42.0–49.8 mm SL), KPM-NI30284 (6, 33.9–57.3 mm SL), KPM-NI30285 (3, 31.5–33.2 mm SL), KPM-NI30291 (1, 47.1 mm SL), KPM-NI30292 (1, 33.1 mm SL), KPM-NI30300 (1, 40.8 mm SL), KPM-NI30301 (2, 34.8–49.4 mm SL), KPM-NI30309 (1, 39.0 mm SL), KPM-NI30321 (2, 48.0–49.4 mm SL), KPM-NI30322 (5, 33.3–44.5 mm SL), KPM-NI30332 (4, 34.5–49.2 mm SL), KPM-NI30333 (3, 34.5–43.7 mm SL), KPM-NI30339 (1, 47.9 mm SL), KPM-NI30340 (2, 39.1–43.0 mm SL), KPM-NI30347 (2, 41.5–52.3 mm SL), KPM-NI30348 (1, 32.1 mm SL), KPM-NI30356 (1, 36.6 mm SL), KPM-NI30357 (1, 29.3 mm SL); ***Salarias luctuosus***: KPM-NI29868 (1, 13.0 mm SL); ***Salarias sinuosus***: KPM-NI24794 (1, 23.9 mm SL), KPM-NI29579 (1, 44.9 mm SL), KPM-NI29580 (1, 52.4 mm SL), KPM-NI29839 (1, 15.7 mm SL), KPM-NI29840 (1, 15.5 mm SL), KPM-NI29844 (1, 23.2 mm SL).

GOBIESOCIDAE—***Conidens laticephalus***: KPM-NI29537 (1, 10.7 mm SL); ***Lepadichthys frenatus***: KPM-NI29643 (1, 19.3 mm SL), KPM-NI29682 (1, 17.7 mm SL), KPM-NI29695 (1, 9.7 mm SL); ***Pherallodus indicus***: KPM-NI29569 (2, 15.6–20.0 mm SL), KPM-NI29586 (3, 16.8–21.9 mm SL), KPM-NI29832 (2, 9.0–13.2 mm SL), KPM-NI29841



(1, 13.7 mm SL), KPM-NI29855 (2, 12.7–12.8 mm SL), KPM-NI29916 (2, 12.3–14.7 mm SL), KPM-NI30178 (1, 16.1 mm SL).

CALLIONYMIDAE—**Neosynchiropus ocellatus**: KPM-NI24906 (1, 11.4 mm SL).

GOBIIDAE—**Asterropteryx semipunctata**: KPM-NI29865 (1, 16.6 mm SL); **Bathygobius coalitus**: KPM-NI29514 (2, 54.3–66.2 mm SL), KPM-NI29605 (1, 62.2 mm SL), KPM-NI29713 (1, 56.4 mm SL), KPM-NI29722 (2, 23.6–26.0 mm SL), KPM-NI29863 (1, 50.7 mm SL), KPM-NI29879 (1, 17.8 mm SL), KPM-NI29880 (1, 45.7 mm SL), KPM-NI29881 (1, 59.5 mm SL), KPM-NI29884 (2, 15.5–29.5 mm SL), KPM-NI30016 (1, 24.3 mm SL), KPM-NI30049 (3, 16.0–22.0 mm SL), KPM-NI30056 (2, 43.1–61.4 mm SL), KPM-NI30079 (4, 31.4–43.5 mm SL), KPM-NI30154 (4, 10.7–32.0 mm SL), KPM-NI30222 (2, 33.0–44.5 mm SL), KPM-NI30232 (1, 9.0 mm SL), KPM-NI30233 (1, 12.1 mm SL), KPM-NI30234 (1, 14.4 mm SL), KPM-NI30242 (1, 40.4 mm SL), KPM-NI30245 (9, 11.0–37.9 mm SL), KPM-NI30274 (1, 71.7 mm SL); **Bathygobius cocosensis**: KPM-NI29524 (1, 37.4 mm SL), KPM-NI29538 (1, 34.8 mm SL), KPM-NI29552 (15, 10.7–35.8 mm SL), KPM-NI29570 (2, 29.8–30.6 mm SL), KPM-NI29587 (1, 34.5 mm SL), KPM-NI29599 (1, 23.7 mm SL), KPM-NI29609 (1, 36.4 mm SL), KPM-NI29616 (3, 32.5–41.6 mm SL), KPM-NI29628 (2, 25.4–28.3 mm SL), KPM-NI29652 (1, 35.3 mm SL), KPM-NI29663 (3, 25.4–32.6 mm SL), KPM-NI29683 (2, 35.3–37.9 mm SL), KPM-NI29712 (6, 11.3–38.5 mm SL), KPM-NI29721 (2, 28.9–32.3 mm SL), KPM-NI29733 (3, 24.7–28.0 mm SL), KPM-NI29741 (2, 12.5–15.7 mm SL), KPM-NI29788 (2, 27.5–31.5 mm SL), KPM-NI29798 (1, 7.7 mm SL), KPM-NI29799 (1, 9.0 mm SL), KPM-NI29800 (1, 9.1 mm SL), KPM-NI29801 (1, 11.3 mm SL), KPM-NI29802 (1, 13.6 mm SL), KPM-NI29813 (14, 17.9–35.8 mm SL), KPM-NI29821 (1, 24.0 mm SL), KPM-NI29833 (7, 13.1–30.5 mm SL), KPM-NI29856 (8, 24.4–33.9 mm SL), KPM-NI29893 (9, 20.6–33.2 mm SL), KPM-NI29898 (5, 21.6–34.8 mm SL), KPM-NI29937 (3, 18.8–32.1 mm SL), KPM-NI29950 (3, 24.8–32.1 mm SL), KPM-NI29951 (3, 9.8–15.8 mm SL), KPM-NI29963 (7, 23.3–40.7 mm SL), KPM-NI29973 (2, 28.1–29.7 mm SL), KPM-NI29997 (3, 22.1–25.3 mm SL), KPM-NI30006 (26, 14.2–25.6 mm SL), KPM-NI30036 (9, 16.6–34.4 mm SL), KPM-NI30048 (8, 12.3–21.0 mm SL), KPM-NI30075 (2, 31.0–32.0 mm SL), KPM-NI30080 (17, 10.0–37.5 mm SL), KPM-NI30099 (6, 24.9–39.1 mm SL), KPM-NI30112 (6, 18.2–28.8 mm SL), KPM-NI30126 (5, 17.9–37.1 mm SL), KPM-NI30145 (2, 17.6–31.3 mm SL), KPM-NI30158 (5, 26.2–33.7 mm SL), KPM-NI30166 (5, 25.0–36.4 mm SL), KPM-NI30189 (1, 35.6 mm SL), KPM-NI30192 (4, 22.0–35.0 mm SL), KPM-NI30206 (11, 8.3–33.5 mm SL), KPM-NI30223 (4, 12.1–30.5 mm SL), KPM-NI30235 (1, 14.7 mm SL), KPM-NI30236 (1, 13.5 mm SL), KPM-NI30246 (6, 13.0–31.4 mm SL), KPM-NI30273 (1, 36.0 mm SL), KPM-NI30281 (11, 24.4–36.7 mm SL), KPM-NI30290 (2, 35.9–36.2 mm SL), KPM-NI30306 (2, 12.9–30.5 mm SL), KPM-NI30313 (1, 15.5 mm SL), KPM-NI30320 (2, 31.8–35.8 mm SL), KPM-NI30330 (1, 25.2 mm SL), KPM-NI30337 (2, 33.8–35.1 mm SL), KPM-NI30350 (1, 33.6 mm SL), KPM-NI30358 (2, 25.2–36.7 mm SL), KPM-NI30363 (8, 12.6–32.2 mm SL), KPM-NI30374 (2, 20.4–26.3 mm SL); **Bathygobius cotticeps**: KPM-NI29525 (1, 29.1 mm SL), KPM-NI30064 (1, 39.1 mm SL), KPM-NI30067 (1, 25.3 mm SL), KPM-NI30068 (1, 22.3 mm SL); **Bathygobius cyclopterus**: KPM-NI24907 (1, 8.7 mm SL), KPM-NI24908 (1, 12.6 mm SL); **Cabillus tongarevae**: KPM-NI24793 (1, 21.4 mm SL); **Eviota abax**: KPM-NI29515 (1, 27.2 mm SL), KPM-NI29715 (1, 30.0 mm SL), KPM-NI29763 (1, 16.5 mm SL), KPM-NI29768 (1, 21.6 mm SL), KPM-NI30008 (1, 21.4 mm

SL), KPM-NI30019 (1, 19.0 mm SL), KPM-NI30055 (1, 17.6 mm SL), KPM-NI30139 (1, 13.5 mm SL); **Eviota japonica**: KPM-NI29716 (1, 23.8 mm SL), KPM-NI29742 (3, 20.0–22.5 mm SL), KPM-NI30050 (1, 21.5 mm SL); **Eviota prasina**: KPM-NI29526 (2, 21.6–24.7 mm SL), KPM-NI29527 (1, 7.9 mm SL), KPM-NI29539 (2, 22.1–30.4 mm SL), KPM-NI29553 (1, 24.3 mm SL), KPM-NI29559 (3, 21.2–25.6 mm SL), KPM-NI29571 (2, 22.0–22.2 mm SL), KPM-NI29588 (15, 8.2–25.0 mm SL), KPM-NI29600 (5, 8.4–24.0 mm SL), KPM-NI29610 (6, 21.8–26.9 mm SL), KPM-NI29617 (6, 23.5–27.8 mm SL), KPM-NI29629 (11, 19.4–22.4 mm SL), KPM-NI29641 (6, 8.5–22.4 mm SL), KPM-NI29656 (1, 21.7 mm SL), KPM-NI29664 (7, 8.9–26.4 mm SL), KPM-NI29666 (1, 24.7 mm SL), KPM-NI29684 (10, 19.4–25.4 mm SL), KPM-NI29696 (10, 10.6–26.0 mm SL), KPM-NI29706 (2, 24.0–25.0 mm SL), KPM-NI29714 (3, 22.3–24.4 mm SL), KPM-NI29734 (14, 8.2–24.5 mm SL), KPM-NI29761 (7, 12.5–19.2 mm SL), KPM-NI29762 (10, 8.3–12.4 mm SL), KPM-NI29789 (4, 16.3–21.1 mm SL), KPM-NI29790 (1, 8.3 mm SL), KPM-NI29814 (5, 11.0–13.2 mm SL), KPM-NI29815 (7, 7.7–8.9 mm SL), KPM-NI29822 (1, 14.9 mm SL), KPM-NI29834 (32, 12.2–20.8 mm SL), KPM-NI29835 (27, 7.4–12.6 mm SL), KPM-NI29857 (65, 12.7–23.6 mm SL), KPM-NI29858 (55, 7.4–12.6 mm SL), KPM-NI29875 (9, 11.5–17.5 mm SL), KPM-NI29876 (3, 8.3–10.9 mm SL), KPM-NI29894 (8, 15.4–25.3 mm SL), KPM-NI29899 (16, 9.5–25.8 mm SL), KPM-NI29917 (21, 14.3–21.0 mm SL), KPM-NI29918 (2, 8.8–11.2 mm SL), KPM-NI29938 (32, 14.6–22.8 mm SL), KPM-NI29939 (20, 10.5–13.8 mm SL), KPM-NI29940 (13, 7.6–9.8 mm SL), KPM-NI29952 (7, 11.5–18.8 mm SL), KPM-NI29953 (2, 7.8–7.9 mm SL), KPM-NI29964 (15, 12.3–23.4 mm SL), KPM-NI29965 (3, 9.1–10.9 mm SL), KPM-NI29974 (26, 12.4–21.7 mm SL), KPM-NI29975 (11, 7.8–11.3 mm SL), KPM-NI29984 (21, 11.9–23.9 mm SL), KPM-NI29985 (7, 7.9–11.7 mm SL), KPM-NI29998 (4, 14.3–18.8 mm SL), KPM-NI30007 (9, 10.2–17.9 mm SL), KPM-NI30018 (6, 12.5–17.3 mm SL), KPM-NI30037 (41, 12.4–23.2 mm SL), KPM-NI30038 (85, 7.4–12.8 mm SL), KPM-NI30074 (6, 11.1–20.9 mm SL), KPM-NI30078 (13, 8.2–20.3 mm SL), KPM-NI30089 (2, 16.8–20.9 mm SL), KPM-NI30098 (18, 10.7–19.6 mm SL), KPM-NI30111 (9, 8.3–18.5 mm SL), KPM-NI30121 (1, 9.0 mm SL), KPM-NI30124 (1, 22.8 mm SL), KPM-NI30125 (25, 10.2–20.5 mm SL), KPM-NI30144 (43, 8.2–21.5 mm SL), KPM-NI30157 (10, 13.2–22.2 mm SL), KPM-NI30165 (11, 8.6–23.8 mm SL), KPM-NI30172 (1, 20.3 mm SL), KPM-NI30180 (35, 8.0–20.6 mm SL), KPM-NI30191 (5, 7.9–18.6 mm SL), KPM-NI30205 (16, 8.6–20.6 mm SL), KPM-NI30221 (4, 8.2–17.7 mm SL), KPM-NI30253 (1, 15.0 mm SL), KPM-NI30277 (1, 21.1 mm SL), KPM-NI30280 (8, 20.4–26.2 mm SL), KPM-NI30289 (2, 21.9–24.9 mm SL), KPM-NI30298 (13, 18.8–27.1 mm SL), KPM-NI30305 (3, 18.6–25.5 mm SL), KPM-NI30315 (6, 18.3–25.4 mm SL), KPM-NI30319 (3, 24.4–26.1 mm SL), KPM-NI30329 (18, 16.3–25.6 mm SL), KPM-NI30336 (4, 18.4–24.3 mm SL), KPM-NI30351 (1, 24.4 mm SL), KPM-NI30362 (1, 21.6 mm SL), KPM-NI30375 (1, 23.5 mm SL); **Palutrus cf. reticularis**: KPM-NI30017 (1, 17.0 mm SL); **Priolepis borea**: KPM-NI29921 (1, 10.4 mm SL); **Priolepis cincta**: KPM-NI29859 (1, 16.6 mm SL); **Priolepis semidoliata**: KPM-NI29540 (1, 30.4 mm SL), KPM-NI29589 (1, 20.5 mm SL), KPM-NI29642 (2, 25.9–26.2 mm SL), KPM-NI29697 (1, 15.8 mm SL), KPM-NI29766 (1, 19.2 mm SL), KPM-NI29776 (1, 23.8 mm SL), KPM-NI29836 (1, 6.9 mm SL), KPM-NI29867 (1, 23.3 mm SL), KPM-NI30023 (1, 6.6 mm SL), KPM-NI30024 (1, 7.3 mm SL), KPM-NI30026 (1, 14.4 mm SL), KPM-NI30143 (2, 17.1–17.2 mm SL), KPM-NI30179 (1, 14.8 mm SL), KPM-NI30328 (3, 14.0–21.8 mm SL).